The 63rd Annual
Merck State Science Day Competition
May 23, 2013
Chemistry

Directions: **To register as a student:**
You will need to ask your teacher for the school phone number used as an identifier for your school.
Fill out the form using your normal email address but please use a password that is NOT associated with any other secure accounts (Your MSSD password).
You must also select the test you will be taking at this time.

On the day of the MSSD competition:
You will be asked to login using your email address and your MSSD Password.
You are encouraged to register early and to log into your test page. Try the Demo Test if you have not already done so.In this demo test, answers are not saved. In a regular test, each answer is stored when **Submit** is used.
When finished, select **FINISHED TEST** in lower left.

Using the Answer Panel
The Demo Test "answer panel" at the bottom of the window is pre-set to show 3 answer boxes per page.
(A normal test may show 10 or more answers per page.)
1. The current question has a black border.
2. Questions that have been answered will be tinted **Green**
3. Click **Submit** to record your answer and scroll to the next test question (even if it is on the next page).
4. Any answer can be edited. Delete your original choice, enter your new letter choice, then **Submit** the correction.
5. **>** moves to the next set of questions (**<** moves back)
6. Click on any number to answer that question.

The test has **60 items** that will be scored. You have **90** minutes in which to answer all the questions.
In addition to the periodic table, there are several subject-specific items below that you may find useful in answering certain questions. Be sure to read them.
INFORMATION THAT MAY BE USEFUL IN SOLVING THE PROBLEMS

Universal gas constant: $\quad$ **R = 0.0821 atm-liter/(mole-K)** **R = 8.31 kPa-liter/(mole-K)**	**1dm^3 = 1 L** **PV=nRT** **Specific heat $_{H2O}$ = 4.184 J/g°C**
1 Faraday ($\Im$) = 96,500 coulombs/mole $\qquad$ **= 96,500 joules/volt** **1 electron volt/atom = 96.5 kilojoules/mole**	**1 calorie = 4.184 joules** **Q = mcΔT** **KE$_{ave}$ = ½mv^2**
Speed of light in vacuum = 3.00 x 10^8 m/sec **Planck's constant, h = 6.63 x 10^{-34} joule-sec** **Boltzmann's constant, k = 1.38 x 10^{-23} joule/K** **Avogadro's number = 6.02 x 10^{23} molecules/mole**	**K$_f$ water = -1.86 °C/m** **K$_b$ water = 0.51°C/m**

The Periodic Table of the Elements

1																	2
H Hydrogen 1.00794																	**He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012182											5 **B** Boron 10.811	6 **C** Carbon 12.0107	7 **N** Nitrogen 14.00674	8 **O** Oxygen 15.9994	9 **F** Fluorine 18.9984032	10 **Ne** Neon 20.1797
11 **Na** Sodium 22.989770	12 **Mg** Magnesium 24.3050											13 **Al** Aluminum 26.981538	14 **Si** Silicon 28.0855	15 **P** Phosphorus 30.973761	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.4527	18 **Ar** Argon 39.948
19 **K** Potassium 39.0983	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.955910	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.9415	24 **Cr** Chromium 51.9961	25 **Mn** Manganese 54.938049	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933200	28 **Ni** Nickel 58.6934	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.39	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.61	33 **As** Arsenic 74.92160	34 **Se** Selenium 78.96	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.80
37 **Rb** Rubidium 85.4678	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.90585	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.90638	42 **Mo** Molybdenum 95.94	43 **Tc** Technetium (98)	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.90550	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.8682	48 **Cd** Cadmium 112.411	49 **In** Indium 114.818	50 **Sn** Tin 118.710	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.60	53 **I** Iodine 126.90447	54 **Xe** Xenon 131.29
55 **Cs** Cesium 132.90545	56 **Ba** Barium 137.327	57 **La** Lanthanum 138.9055	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.9479	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.078	79 **Au** Gold 196.96655	80 **Hg** Mercury 200.59	81 **Tl** Thallium 204.3833	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.98038	84 **Po** Polonium (209)	85 **At** Astatine (210)	86 **Rn** Radon (222)
87 **Fr** Francium (223)	88 **Ra** Radium (226)	89 **Ac** Actinium (227)	104 **Rf** Rutherfordium (261)	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (263)	107 **Bh** Bohrium (262)	108 **Hs** Hassium (265)	109 **Mt** Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.90765	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (145)	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.92534	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.93032	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.93421	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.967
90 **Th** Thorium 232.0381	91 **Pa** Protactinium 231.03588	92 **U** Uranium 238.0289	93 **Np** Neptunium (237)	94 **Pu** Plutonium (244)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (247)	98 **Cf** Californium (251)	99 **Es** Einsteinium (252)	100 **Fm** Fermium (257)	101 **Md** Mendelevium (258)	102 **No** Nobelium (259)	103 **Lr** Lawrencium (262)

Multiple Choice
*Identify the choice that best completes the statement or answers the question and enter it in the answer window on the computer screen, then **SUBMIT**.*

1. A sample of a pure solid is heated at a constant rate and its temperature recorded as a function of time. A graph of the data is shown. Which statement is true about this substance?
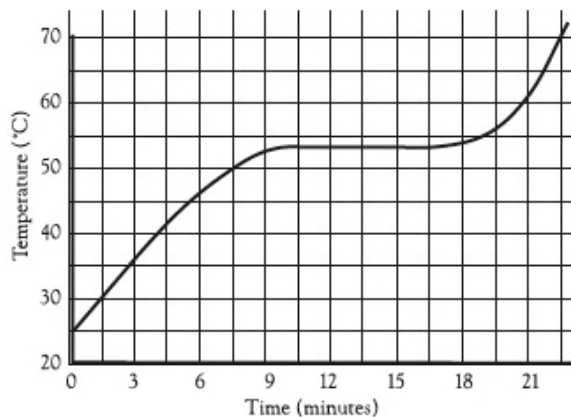
A) The substance would melt in your hand
B) The boiling point would be about 100°C.
C) The ΔH_{vap} would be larger than the ΔH_{fus}.
D) If an non-volatile impurity was added, the melting point would be higher.
E) The time that it takes to melt the solid is directly related to the molar mass of the substance.

2. Carbon-14 nuclei are radioactive, decaying to ^{14}N. The following data show the change in activity of a sample containg ^{14}C in units of counts per minute (cpm) versus the age of the sample in years.

Activity (cpm)	Age (year)
1000	0
988	100
941	500
886	1000
785	2000
298	10000

What is the half-life of C-14 in years?

A) 55
B) 101
C) 487
D) 4985
E) 5730

3. Small, but equal, masses of each of these compounds are added to separate 1 L containers of water at 25°C. Which solution would be the best electrical conductor?
   A) CH_3F
   B) NaF
   C) CF_4
   D) CaF_2
   E) OF_2

4. A 1.00-g sample of an organic compound was burned in pure oxygen and found to produce 2.20 g of carbon dioxide and 0.400 g of water.What is the empirical formula of the compound?
   A) C_9H_2
   D) $C_9H_8O_4$
   B) $C_9H_2O_{19}$
   E) $C_9H_4O_4$
   C) $C_{11}H_4O_{24}$

5. A container of isopropyl alcohol (2-propanol or IPA) is labeled as 70% alcohol by volume. What volume of this solution must be mixed with water in order to make 1.00 L of 50% alcohol?
   A) 200 mL
   B) 286 mL
   C) 350 mL
   D) 500 mL
   E) 714 mL

6. Assume that you have an "unknown" consisting of an aqueous solution of a salt that contains one of the ions listed below. Which ion must be **absent** on the basis of all of the observations below.
   I. The solution is colorless.
   II. No odor can be detected when a sample of the solution is added drop by drop to a warm solution of sodium hydroxide.
   III. Only a precipitate is observed when a dilute solution of H_2SO_4 is added to a sample of the solution.
   A) CO_3^{2-}
   D) Ba^{2+}
   B) $Cr_2O_7^{2-}$
   E) Al^{3+}
   C) NH_4^+

7. The spontaneous reaction that occurs when the cell above operates is:

$$2\,Ag^+ + Cd(s) \rightarrow 2\,Ag(s) + Cd^{2+}$$
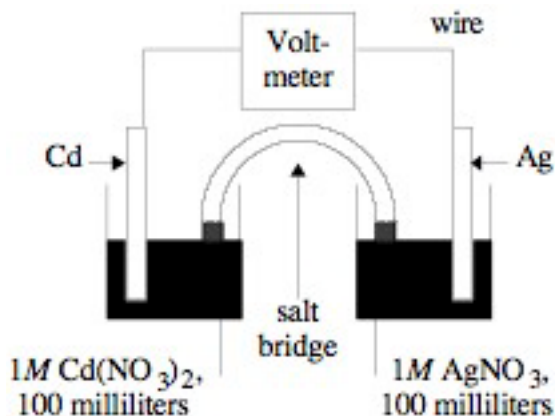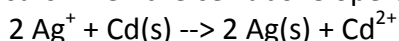
What occurs when a dilute solution of sodium sulfide is added to the left beaker?
A) Voltage increases.
B) Voltage decreases be remains above zero.
C) Voltage becomes zero and remains at zero
D) No change in voltage occurs.
E) Direction of voltage change cannot be predicted without additional information.

8. ...$Mg(s)$ + ...$NO_3^-(aq)$ + ...$H^+(aq) \rightarrow$ ...$Mg^{2+}(aq)$ +...$NH_4^+(aq)$ + ...$H_2O(l)$
When the expression above is balanced and all the coefficients reduced to their lowest whole-number terms, what is the coefficient for the H^+?
**A)** 6   **D)** 10
B) 8   **E)** 14
C) 9

9. Atoms of an element, X, have the electronic configuration shown below.
$$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$$
The compound most likely formed with barium, Ba, is
A) BaX   **D)** BaX_3
B) Ba_2X **E)** Ba_3X_2
C) BaX_2
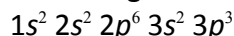
10. The critical temperature of a substance is the
A) temperature at which the vapor pressure of the liquid is equal to the external pressure.
B) temperature at which the vapor pressure of the liquid is equal to 760 mm Hg.
C) temperature at which the solid, liquid, and vapor phases are all in equilibrium.
D) temperature at which liquid and vapor phases are in equilibrium at 1 atmosphere.
E) lowest temperature above which a substance cannot be liquefied at any applied pressure.

11. If the equilibrium constant for the reaction below is 3.7×10^{15}, which statement correctly describes the standard voltage, $E°$, and the standard free energy change, $\Delta G°$, for this reaction?

$$Cu_{(s)} + 2\ Ag^+ \rightarrow Cu^{2+} + 2\ Ag_{(s)}$$
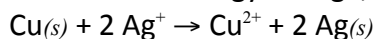
A) $E°$ is positive and $\Delta G°$ is negative.   D) $E°$ and $\Delta G°$ are both negative

B) $E°$ is negative and $\Delta G°$ is positive   E) $E°$ and $\Delta G°$ are both zero

C) $E°$ and $\Delta G°$ are both positive

12. When $^{214}_{84}Po$ decays, the emission consists consecutively of an α particle, then two β particles, and finally another α particle. The resulting stable nucleus is

A) $^{206}_{83}Bi$

B) $^{210}_{83}Bi$

C) $^{206}_{82}Pb$

D) $^{208}_{82}Pb$

E) $^{210}_{81}Tl$

13. Which aqueous solution is **NOT** blue or blue-green?

A) $CuCO_3$

B) $NiSO_4$

C) $MnMoO_4$

D) $Fe_4[Fe(CN)_6]_3$

E) $CoCl_2$

14. Which is the net ionic equation for the reaction between silver carbonate and hydrochloric acid?

A) $Ag_2CO_{3(s)} + 2\ H^+ + 2\ Cl^- \rightarrow 2\ AgCl_{(s)} + H_2O + CO_{2(g)}$

B) $2\ Ag^+ + CO_3^{2-} + 2\ H^+ + 2\ Cl^- \rightarrow 2\ AgCl_{(s)} + H_2O + CO_{2(g)}$

C) $CO_3^{2-} + 2\ H^+ \rightarrow H_2O + CO_{2(g)}$

D) $Ag^+ + Cl^- \rightarrow AgCl_{(s)}$

E) $Ag_2CO_{3(s)} + 2\ H^+ \rightarrow 2\ Ag^+ + H_2CO_3$

15. The addition of an oxidizing agent such as chlorine water to a clear solution of an unknown compound results in the appearance of a brown color. When this solution is shaken with the organic solvent, hexane, the organic solvent layer turns purple. The unknown compound probably contains

A) K^+

B) Br^-

C) NO_3^-

D) I^-

E) Co^{2+}

16. Equal masses of three different ideal gases, X, Y, and Z, are mixed in a sealed rigid container. If the temperature of the system remains constant, which of the following statements about the partial pressure of gas X is correct?
    A) It is equal to $\frac{1}{3}$ the total pressure.
    B) It depends on the intermolecular forces of attraction between molecules of X, Y, and Z.
    C) It depends on the relative molecular masses of X, Y, and Z.
    D) It depends on the average distance traveled between molecular collisions.
    E) It can be calculated with knowledge only of the volume of the container.

17. The geometry of the SO_3 molecule is best described as
    A) trigonal planar
    B) trigonal pyramidal
    C) square pyramidal
    D) bent
    E) tetrahedral

18. Which molecule has the shortest bond length?
    A) N_2
    B) O_2
    C) Cl_2
    D) Br_2
    E) I_2
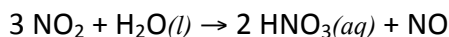
19. Nitrogen reacts with hydrogen to form ammonia

$$N_2 + 3\,H_2 \rightarrow 2\,NH_3$$
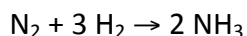
which burns in the presence of oxygen to form nitrogen oxide

$$4\,NH_3 + 5\,O_2 \rightarrow 4\,NO + 6\,H_2O$$
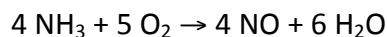
which reacts with excess oxygen to form nitrogen dioxide

$$2\,NO + O_2 \rightarrow 2\,NO_2$$
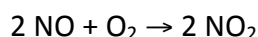
which dissolves in water to give nitric acid.

$$3\,NO_2 + H_2O_{(l)} \rightarrow 2\,HNO_{3(aq)} + NO$$

(all gases unless otherwise indicated)

Calculate the mass of nitrogen needed to make 189 g of nitric acid.
    A) 31.5 g
    B) 42.0 g
    C) 63.0 g
    D) 84.0 g
   E) 168 g

20. $CH_4(g) + 2 O_2(g) \rightarrow CO_2(g) + 2 H_2O(l)$ $\Delta H° = -889.1$ kJ

$\Delta H_f° \ H_2O(l) = -285.8$ kJ

$\Delta H_f° \ CO_2(g) = -393.3$ kJ

What is the standard heat of formation of methane, $\Delta H_f° \ CH_4(g)$, as calculated from the data above?

A) -210.0 kJ

B) -107.5 kJ

C) -75.8 kJ

D) 75.8 kJ

E) 210.0 kJ

21. Which ion is the strongest Lewis acid?

A) Na^+

B) Cl^-

C) CH_3COO^-

D) Mg^{2+}

E) Al^{3+}

22. Under what conditions would a reaction be thermodynamically favored?

A) $\Delta H°>0, \Delta S°>0$

B) $\Delta H°>0, \Delta S°<0$

C) $\Delta H°<0, \Delta S°>0$

D) $\Delta H°<0, \Delta S°<0$

E) $\Delta G°<0, K=0$

23. Which species has the greatest number of pi (π) bonds?

A) CO_2

B) C_2H_4

C) CN^-

D) C_6H_6

E) C_6H_{14}

24. An acidified solution of iron(II) sulfate or ferrous sulfate, is added to a solution of potassium dichromate. What are the products of this reaction?

A) $FeCr_2O_7(s) + H_2O$

B) $Fe_2(CrO_4)_3(s) + H_2O$

C) $Cr^{3+} + Fe(s) + H_2O$

D) $Fe^{3+} + Cr^{3+} + H_2O$

E) $Fe_3(SO_4)_2(s) + Cr^{3+} + H_2O$

25. Atoms of which elements would be paramagnetic?

As, Ca, Co, V, Zn

A) As and Ca only
B) As and Zn only
C) Ca, Co, and Zn only
D) As, Co, and V only
E) Co, V, and Zn only

26. The molar mass (molecular weight) of the material in a liquid filled cigarette lighter is to be determined using an apparatus similar to the illustration below. The lighter is massed and recorded, a sample of gas is passed through an inverted measuring cylinder filled with water and the gas volume is measured. The lighter is remassed, recorded, and the temperature of the water collected. What other information is need to be measured or referenced in order to determine the molar mass?
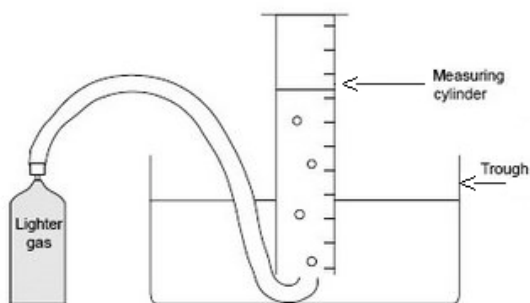
A) the barometric pressure only
B) the vapor pressure of the water
C) the barometric pressure and the vapor pressure of water
D) the pressure inside the lighter
E) the chemical composition of the liquid in the lighter
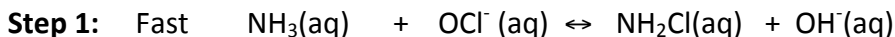
27. Which molecule would exhibit optical isomerization?
A) trichloromethane
B) aminoacetic acid
C) cis-1,2-difluoroethene
D) trans 1,2 difluoroethene
E) para aminobenzoic acid

28. Each of these molecules has the formula of C_5H_{12}
I n-pentane
II 2-methyl butane
III 2,2-dimethyl propane
Which would have the highest boiling point?
A) I
B) II
C) III
D) II & III
E) all would be the same

29. Which one is NOT a strong base?
A) NaOH
B) KOH
C) $Ca(OH)_2$
D) $Mg(OH)_2$
E) $Cu(OH)_2$

30. The grouping of elements have most nearly the same atomic radius?
A) Be, B, C, N
B) C, P, Se, I
C) Cr, Mn, Fe, Co
D) Mg, Ca, Sr, Ba
E) Ne, Ar, Kr, Xe

31. If you add 1.2 kg of ethylene glycol, $HOCH_2CH_2OH$, as antifreeze to 4.0 kg of water in the radiator of your car, determine the lowest temperature that your car can be safely outdoors. (K_f =1.86°C/m)
A) -341°C
B) -103°C
C) -17.9°C
D) -8.93°C
E) 8.93°C

32. What is the pH of a 0.2M solution of aniline, $C_6H_5NH_2$.? (K_b =3.8 x 10^{-10})
A) 3.88
B) 5.05
C) 8.94
D) 9.29
E) 10.12

33. Consider the following reaction:

$$2\ NH_3(aq) + OCl^-(aq) \rightarrow Cl^-(aq) + N_2H_4(aq) + H_2O(l)$$

Given this reaction mechanism:

Step 1: Fast $\quad NH_3(aq)\ +\ OCl^-(aq) \leftrightarrow NH_2Cl(aq)\ +\ OH^-(aq)$

Step 2: Slow $\quad NH_2Cl(aq)\ +\ NH_3(aq)\ \rightarrow\ N_2H_5^+(aq)\ +\ Cl^-(aq)$

Step 3: Fast $\quad N_2H_5^+(aq)\ +\ OH^-(aq)\ \rightarrow\ N_2H_4(aq)\ +\ H_2O(l)$

What is the rate equation for the reaction?
A) rate = $k[NH_3]^2[OCl^-]$
B) rate = $k[NH_2Cl][NH_3]$
C) rate = $k[NH_3][OCl^-]$
D) rate = $k\ [N_2H_5^+][OH^-]$
E)
$$rate = k\frac{[N_2H_5^+][Cl^-]}{[NH_2Cl][NH_3]}$$

34. What is the molar mass, in g/mol, of a gas when a 1.00-gram sample in a 256 mL container at 22.3°C has a pressure of 70.5 torr? (R= 0.0821 $\frac{L \cdot atm}{mol \cdot K}$)

A) 1.02 D) 98.5
B) 1.34 E) 1020
C) 83.3

35.
If 0.060 faraday is passed through an electrolytic cell containing a solution of In^{3+} ions, what is the maximum number of moles of indium, In, that could be deposited at the cathode?
A) 0.010 mol
B) 0.020 mol
C) 0.030 mol
D) 0.060 mol
E) 0.18 mol

36. A gaseous mixture containing 196 grams of nitrogen, 80.0 grams of oxygen, and 2.0 grams of helium exerts a total pressure of 0.90 atmosphere. What is the partial pressure of the nitrogen?
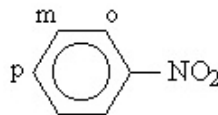A) 0.63 atm
B) 0.71 atm
C) 6.3 atm
D) 9.0 atm
E) 176 atm

**37.** What mass of calcium phosphate, $Ca_3(PO_4)_2$, contains 24 grams of oxygen atoms?

A) 29.1 g
B) 50.6 g
C) 58.1 g
D) 116 g
E) 465 g

38. Nitrobenzene (below) reacts by electrophilic aromatic substitution. When it reacts with gaseous fluorine, you would expect to find the fluorine at which position(s)?

A) ortho (o)
B) meta (m)
C) para (p)
D) ortho and para
E) all positions are equal

39. The bond angle in water is about 105°. What would you expect for the bond angle in H_2Se?
A) about 10% smaller
B) about 10% larger
C) about the same
D) 180°
E) H_2Se does not exist

40. What is the anomeric effect?
A) When an alkyl-magnesium halide adds to a carbonyl group in a ketone.
B) The production of a reaction intermediate that creates a catalyst for the reaction.
C) The unusual tendency for a reaction at the axial position instead of an equatorial position in a 6-member organic ring.
D) In quantum mechanics, the more precisely the position of a particle is know the less precisely its momentum is known.
E) A way of describing delocalized electrons in a polyatomic ion where the bonding cannot be described by a single Lewis formula.

41. Potassium is allowed to react in pure oxygen. What is the product of this reaction?
A) KO
B) K_2O
C) K_2O_2
D) KO_2
E) K_2O_4

42. What is the ΔH for the reaction of iso-octane (2,3,3-trimethyl pentane), the main isomer in gasoline, with oxygen?
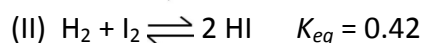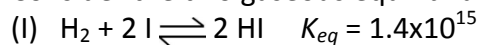
$$C_8H_{18} + 25/2\ O_2 \rightarrow 8\ CO_2 + 9\ H_2O$$
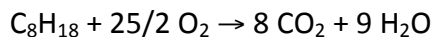
Bond Dissociation Enthalpy (kJ/mol)

C-C	350
C=C	611
C≡C	837
C-H	415
C-O	360
C=O	745
O-O	140
O=O	498
O-H	464

A) -4127 kJ
B) -3777 kJ
C) -2033 kJ
D) 3777 kJ
E) 4127 kJ

43. The most stable form of sulfur consists of yellow crystals of S_8 molecules. What is the type of crystal?
A) monoclinic
B) orthorhombic
C) octahedral
D) ditetrahedral
E) cubic closest-packed

44. Liquid crystals are now used in electronic displays such as digital watches and calculators. Which is a type of liquid crystal?
A) p-type
B) chelate
C) cholesteric
D) bidentate
E) nucleophilic

45. Consider the two gaseous equilibrium reactions below.
   (I) $H_2 + 2I \rightleftharpoons 2HI$ $K_{eq} = 1.4 \times 10^{15}$
   (II) $H_2 + I_2 \rightleftharpoons 2HI$ $K_{eq} = 0.42$
   What is the value of the equilibrium constant for reaction (III)?
   (III) $I_2 \rightleftharpoons 2I$ (all gases)
   A) 7.1×10^{-16}
   B) 3.0×10^{-16}
   C) 5.9×10^{14}
   D) 3.3×10^{14}
   E) 1.4×10^{15}
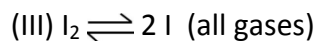
46. Phosphorus pentachloride decomposes to phosphorus trichloride and chlorine when heated.
   $$PCl_5 \rightleftharpoons PCl_3 + Cl_2 \quad \text{(all gases)}$$
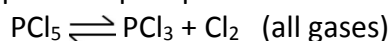
   The equilibrium constant for this reaction at 250°C is 0.030. What is the concentration of PCl_5 at equilibrium if the initial concentration 0.100 M?
   A) 0.042 M
   B) 0.058 M
   C) 0.055 M
   D) 0.045 M
   E) 0.17 M

47. What is the concentration of sulfide ions in a 500 mL saturated solution of Ag_2S if 1.00 millimole of $AgNO_3$ has been added? K_{sp} of $Ag_2S = 6.3 \times 10^{-50}$
   A) 1.6×10^{-44}
   B) 3.2×10^{-47}
   C) 6.3×10^{-44}
   D) 6.3×10^{-47}
   E) 2.5×10^{-17}

48. Silver ions, Ag+, can generally complex with which species?
   I Cl^-
   II NH_3
   III CN^-
   IV $S_2O_3^{2-}$
   A) II only
   B) I & II only
   C) II & III only
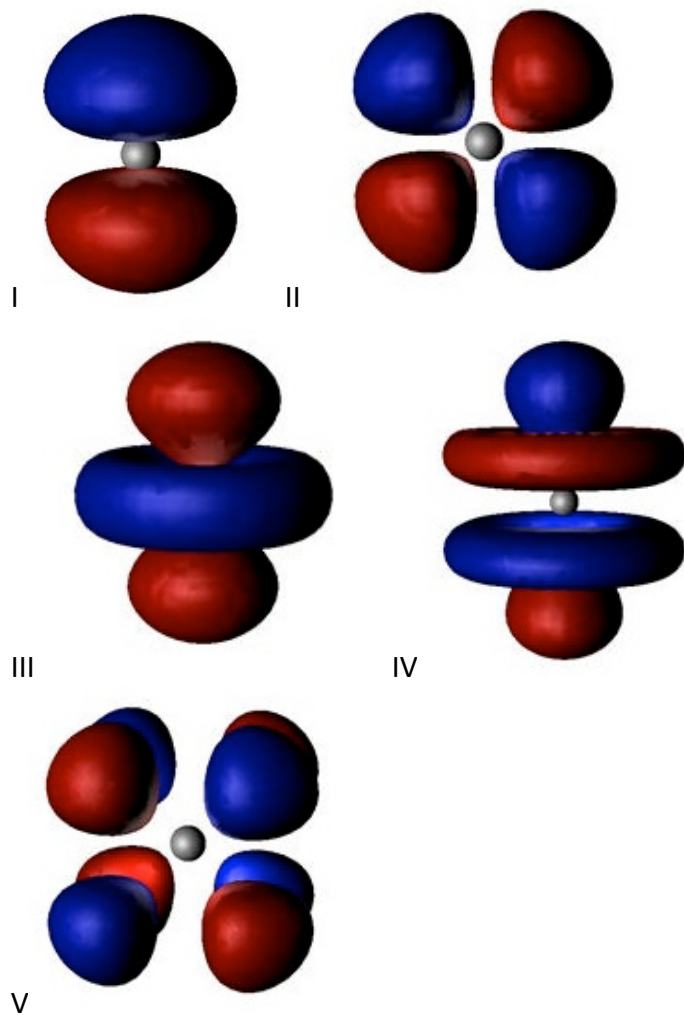   D) I, III, & IV only
   E) all of them
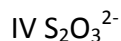
49. What is the most common oxidation state of the first-row transistion metal ions?
    A) 0
    B) +1
    C) +2
    D) +3
    E) -2

50. Which drawing(s) represent(s) d-orbitals?

I

II

III

IV

V

    A) I only
    B) II only
    C) II & III only
    D) III & IV only
    E) I, II, & V only

51. Determine the energy released by a mole of photons of wavelength 5.6 x 10^{-6} meters/sec. (h= 6.626 x 10^{-34} J·s/cycle)

   A) 1.24 x 10^{-47} J/mole
   B) 7.45 x 10^{-24} J/mole
   C) 3.55 x 10^{-16} J/mole
   D) 2.23 x 10^{-13} J/mole
   E) 2.14 x 10^{4} J/mole

52. Which synthetic fiber has the same kind of bonds linking the monomers as protein?
   A) dacron
   B) nylon
   C) orlon
   D) rayon
   E) polypropylene

53. Which would NOT conduct an electrical current?
   A) solid Na
   B) liquid Na
   C) solid NaCl
   D) liquid NaCl
   E) NaCl dissolved in water

54. When chlorine, Cl$_2$, and fluorine, F$_2$, react they form ClF$_3$ but not FCl$_3$. What is the reason for this?
   A) Fluorine is the most electronegative element.
   B) A chlorine atom is bigger than fluorine atom.
   C) Chlorine has a lower electronegativity than fluorine.
   D) Chlorine is more abundant in nature than fluorine.
   E) Fluorine has a smaller molar mass than chlorine.

55. The molality of the glucose in a 1.0-molar glucose solution can be obtained by using which of the following?
   A) Volume of the solution
   B) Temperature of the solution
   C) Solubility of glucose in wate
   D) Degree of dissociation of glucose
   E) Density of the solution

Matching

A) hydrofluoric acid
B) carbon dioxide
C) aluminum hydroxide
D) ammonia
E) hydrogen peroxide

56. Is a good oxidizing agent

57. Is used to etch glass chemically

58. Is used extensively for the production of fertilizers

59. Has amphoteric properties

60. Is an acid anhydride

The End

MULTIPLE CHOICE

1.	C	**31.**	D
2.	E	**32.**	C
3.	~~D~~ B	**33.**	B
4.	D	**34.**	E
5.	E	**35.**	B
~~**6.**~~	~~D~~ eliminated	**36.**	A
7.	A	**37.**	C
8.	D	**38.**	B
9.	E	**39.**	A
10.	E	**40.**	C
11.	A	**41.**	D
12.	C	**42.**	A
13.	C	**43.**	B
14.	A	**44.**	C
15.	D	**45.**	B
16.	C	**46.**	B
17.	~~C~~ A	**47.**	A
18.	A	**48.**	E
19.	C	**49.**	C
20.	C	**50.**	C
21.	E	**51.**	E
22.	C	**52.**	B
23.	D	**53.**	C
24.	D	**54.**	B
25.	D	**55.**	E
26.	C	**56.**	E
~~**27.**~~	~~B~~ eliminated	**57.**	A
28.	A	**58.**	D
29.	E	**59.**	C
30.	C	**60.**	B