New Jersey Science League – Chemistry I Exam

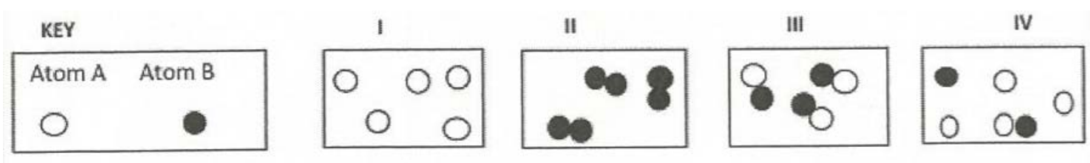
January 2018 PINK TEST

Choose the answer that best completes the statement or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. You may use the given periodic table and formula sheet as well as a calculator. On the formula sheets is a table of the activity series of the elements. Please PRINT your name, school, area and which test you are taking on to the scan-tron.

1. Which of the following is an example of a chemical property?
   A. color C. the ability to rust
   B. density D. phase changes

2. Atoms have no electric charge because they:
   A. Have an equal number of charged and noncharged particles
   B. Have neutrons in their nuclei
   C. Have an equal number of electrons and protons
   D. Have an equal number of neutrons and protons

Question 3-5 refer to the diagram below.



3. Which of the diagrams represents a pure substance?
   A. I only C. I, II and III
   B. I and II D. I, II, III, and IV

4. Which of the diagrams represents a mixture?
   A. I C. III
   B. II D. IV

5. Which of the following describes diagram III above?
   A. It is a mixture composed of substances chemically combined
   B. It is a mixture composed of substances physically combined
   C. It is a compound composed of substances chemically combined
   D. It is a compound composed of substances physically combined

6. The percent composition of aluminum by mass in aluminum hydroxide is:
   A. 50% C. 14%
   B. 35% D. None of these answers are correct.

7. N_2S_3 is properly named:
   A. nitrogen sulfide C. nitrogen (II) sulfide
   B. nitrogen (III) sulfide D. dinitrogen trisulfide

8. What piece of laboratory equipment is best-suited for accurately measuring the volume of a liquid?
   A. graduated cylinder
   B. beaker
   C. Erlenmeyer flask
   D. more than one of the above

9. A 12.3 g block of an unknown metal is immersed in water in a graduated cylinder. The level of the water in the cylinder rose. The level of the water in the cylinder rose exactly the same distance when 17.4 grams of aluminum (density 2.70 g/ml) was added to the same cylinder. What is the unknown metal's density?
   A. 4.55 g/ml
   B. 6.44 g/ml
   C. 1.91 g/ml
   D. Cannot be determined for the information given

10. The independent variable in an experiment is:
    A. The variable you hope to observe in an experiment.
    B. The variable you change in an experiment.
    C. The variable that isn't changed in an experiment.
    D. none of these is correct

11. What is the balanced equation for the reaction that takes place between bromine and sodium iodide?
    A. $Br_2 + NaI \rightarrow NaBr_2 + I_2$
    B. $Br_2 + 2NaI \rightarrow 2NaBr + I_2$
    C. $Br_2 + 2NaI \rightarrow 2NaBr + 2I$
    D. $Br + NaI_2 \rightarrow NaBrI_2$

12. A sample of gold alloy is 5.6 % silver by mass. How many grams of silver are there in 1kg of the alloy?
    A. 56 g
    B. 0.056 g
    C. 5600 g
    D. 5.6 g

13. Measurements of the boiling point of a liquid were taken by two laboratory technicians. The actual boiling point was 92.3^{o}C. Which technician achieved the most accurate results and which technician was the most precise.

Technician A	Technician B
90.0	92.6
90.1	92.0
90.1	92.1
89.8	92.3

    A. A is accurate and B is precise
    B. B is accurate and A is precise
    C. Both are accurate and precise
    D. Neither is accurate or precise

14. Write the balanced equation for the complete combustion of propane (C_3H_8). When properly balanced, the equation indicates that _____ moles of O_2 are required for each mole of C_3H_8.
   A. 0
   B. 1
   C. 5
   D. 10

15. Calculate the mass, in grams, of hydrogen formed when 25 g of aluminum reacts with excess hydrochloric acid
   $2\,Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$
   A. 25
   B. 2.8
   C. 1.9
   D. 1.4

16. How many molecules are in 35.0 grams of H_2O?
   A. 2.1×10^{25}
   B. 6.02×10^{23}
   C. 1.17×10^{24}
   D. 1

17. Which particle was used by Ernest Rutherford as a "probe" in his classic experiment on the atom?
   A. alpha
   B. beta
   C. gamma
   D. alpha and beta, but not gamma

18. JJ Thomson's cathode ray tube demonstrated that electrons have _______ charge.
   A. A positive
   B. A negative
   C. No charge
   D. It cannot be determined
   E.

19. One gram of which of the following contains the **largest** number of molecules?
   A. CH_4 B. NH_3 C. HNO_3 D. N_2 E. H_2O

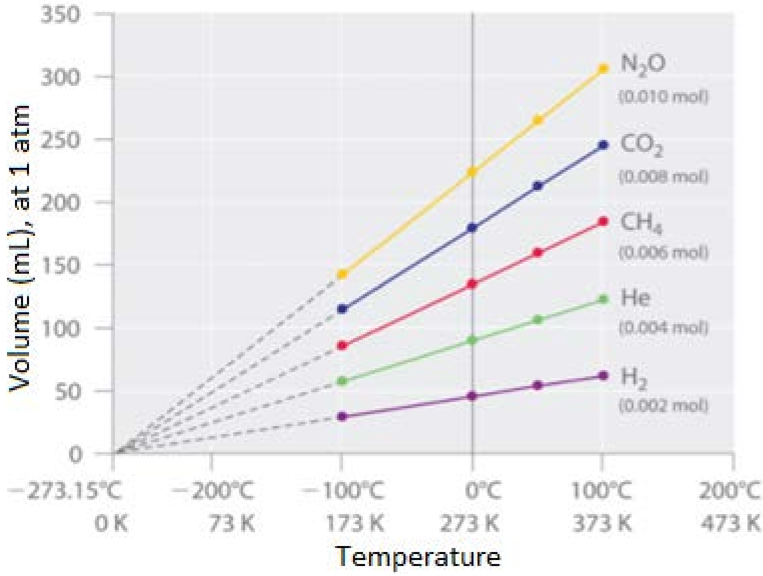
20. Which has the highest percentage of oxygen by mass?
   A. $NaHCO_3$
   B. $(NH_4)_2SO_4$
   C. $Na_2S_2O_3$
   D. H_2O_2

21. Chemical reactions _____.
   A. occur only in living organisms
   B. create and destroy atoms
   C. only occur outside living organisms
   D. produce new substances

22. In order for the reaction $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$ to occur, which one of the following must be true?
   A. Al must be above Cl on the activity series
   B. Al must be above H on the activity series
   C. Heat must be supplied for the reaction
   D. A precipitate must be formed

23. In a double-replacement reaction, the ____.
    A. Products are always molecular
    B. Reactants are two ionic compounds
    C. Reactants are two elements
    D. Products are a new element and a new compound

24. The graph below represents the relationship between volume and temperature. According to the graph, which variable is the dependent variable?



    A. Temperature
    B. Volume
    C. H_2
    D. N_2O

25. According to the law of conservation of mass, the total mass of the reacting substances is
    A. always more than the total mass of the products
    B. always less than the total mass of the products
    C. sometimes more and sometimes less than the total mass of the products
    D. always equal to the total mass of the products.

Periodic Table and Chemistry Formulae Final copy 12-21-2017

Periodic Table of the Elements
amu to 4 significant figures

1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Ds** (281)	111 **Rg** (272)	112 **Cn** (285)	113 (Uut) (284)	114 **Fl** (289)	115 (Uup) (288)	116 **Lv** (293)	117 (Uus) (294)	118 (Uuo) (294)

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0	**Lanthanide Series**
90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)	**Actinide Series**

CHEMISTRY FORMULAS

GASES, LIQUIDS, SOLUTIONS

PV = nRT

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

$$P_A = P_{total} \bullet X_A$$

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

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

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

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
Keq = equilibrium constant

R, Gas constant = $\frac{\text{8.31 Joules}}{\text{Mole Kelvin}}$

= $\frac{\text{0.0821 liter atm}}{\text{mole Kelvin}}$

= $\frac{\text{8.31 volts coulombs}}{\text{mole Kelvin}}$

Boltzmann's constant,
k = 1.38 x 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 = 760 mm of Hg = 760 Torr) = 14.7 psi

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

°C x 9/5 + 32 = °F
(°F - 32) x 5/9 = °C

ATOMIC STRUCTURE

$\Delta E = h\nu$

$c = \nu\lambda$

$\lambda = \dfrac{h}{mv}$

$p = mv$

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

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

where a B + b B $\leftrightarrow$ c C + d D

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

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

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

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

EQUILIBRIUM

$K_w = 1 \times 10^{-14}$ at 25°C

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

$pH + pOH = 14$

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

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

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

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

Δn = moles product gas – moles reactant gas

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

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

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

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

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

$q = mC\Delta T$

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

$q = mH_f$

$q = mH_v$.

$\Delta U = \Delta H - P\Delta V$

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

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

Water $H_f = \dfrac{330 \text{ joules}}{\text{gram}}$

Water $H_v = \dfrac{2260 \text{ joules}}{\text{gram}}$

ΔU = change internal energy of a system
ΔH= change in energy of a system
$-P\Delta V$ = work of gases
1liter-atm = 101.325 J

Metal Activity Series

Metal	Metal Ion
Li	Li^{+1}
K	K^{+1}
Ba	Ba^{+2}
Ca	Ca^{+2}
Na	Na^{+1}
Mg	Mg^{+2}
Al	Al^{+3}
Mn	Mn^{+2}
Zn	Zn^{+2}
Cr	Cr^{+3}
Fe	Fe^{+2}
Co	Co^{+2}
Ni	Ni^{+2}
Sn	Sn^{+2}
Pb	Pb^{+2}
H_2	$2\ H^{+1}$
Cu	Cu^{+2}
Ag	Ag^{+1}
Hg	Hg^{+2}
Pt	Pt^{+2}
Au	Au^{+3}

Chemistry I Answer Key PINK TEST
Date: January 2018

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

CHEMISTRY 1 For Honor's, Enriched or College Prep. Not for AP or Second year students. 25 multiple choice questions per exam. Try to include drawings, lab data, and graphs on each test.

All questions deal with the applications of chemical concepts not just memorization of ideas or steps.

January Test: scientific method, measurement, factor label conversions, properties, graphing, mixtures, compounds, formulas, mole, weight percent, chemical reactions, using the metal and non-metal activity series for writing chemical reactions, types of reactions, stoichiometry, atomic structure and history which includes alpha, beta, gamma radiation, but not electronic configuration.

February Test: Quantum Theory, Electronic structure, orbital notation, dot notation, Coulomb's Law, periodic behavior, specific heat, heat of phase changes, molar heat of fusion, molar heat of vaporization, graphs of phase changes, plus January topics Review.

March Test: Chemical bonding, molecular structure, simple isomers, intermolecular attractions, redox but not balancing redox equations, kinetic theory, solids, liquids, gases, gas laws, gas Stoichiometry, mole fraction as applied to gases, plus January and February topics Review.

April Test: solutions, use of solubility rules, reaction rates, chemical equilibrium, entropy, reaction spontaneity, Keq, acids, bases, salts, net ionic equations, thermo chemistry, ΔH, Hess's law, radioactive decay reactions, plus January, February, and March topics Review.

Dates for 2018 Season

Thursday January 11, 2018 Thursday February 8, 2018
Thursday March 8, 2018 Thursday April 12, 2018
All areas and schools must complete the April exam and mail in the results by April 28th, 2018

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Web address: http://entnet.com/~personal/njscil/html/

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 2019 Season

Thursday January 10, 2019 Thursday February 7, 2019
Thursday March 7, 2019 Thursday April 11, 2019

New Jersey Science League – Chemistry I Exam Corrections
February 2018 PINK TEST

Choose the answer that best completes the statement or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. You may use the given periodic table and formula sheet as well as a calculator. On the formula sheets is a table of the activity series of the elements. Please PRINT your name, school, area and which test you are taking on to the scan-tron.

1. Bromine exists naturally as a mixture of bromine-79 and bromine-81 isotopes. An atom of bromine-79 contains

A. 35 protons, 44 neutrons, 35 electrons
B. 44 protons, 44 electrons and 35 neutrons
C. 35 protons, 79 neutrons and 35 electrons
D. 79 protons, 79 electrons and 35 neutrons

2. Which of the following is incorrectly named?

A. $Pb(NO_3)_2$, lead (II) nitrate
B. NH_4ClO_4, ammonium perchlorate
C. $CuSO_4$, copper (I) sulfate
D. $FePO_4$, iron (III) phosphate

3. What is the mass of **one atom** of copper in grams?

A. 63.5 g
B. 52.0 g
C. 9.48×10^{21} g
D. 1.06×10^{-22} g

4. A given sample of xenon fluoride contains molecules of a single type XeF_n, where n is some whole number. Given that 9.03×10^{20} molecules of XeF_n weigh 0.31 g, determine the value of n

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

5. What is the coefficient for oxygen when the following equation is balanced using the smallest whole number coefficients?

$$NH_{3(g)} + O_{2(g)} \rightarrow NO_{2(g)} + H_2O_{(g)}$$

A. 3
B. 6
C. 7
D. 14

6. A mixture of $BaCl_2$ and NaCl is analyzed by precipitating all the barium as barium sulfate. After the addition of an excess of Na_2SO_4 to a 3.988 g sample of the mixture, the mass of precipitate collected is 2.113 g. What is the mass percent of barium chloride in the mixture?

A. 59.40%
B. 52.98%
C. 31.17%
D. 47.26%

7. When a hydrogen electron makes a transition from n=3 to n=1, which of the following statements is/are true?

I. Energy is emitted
II. Energy is absorbed
III. The electron loses energy
IV. The electron gains energy
V. No energy is associated with this transition

A. I and IV
B. I and III
C. II and III
D. II and IV
E. V

8. Which of the following atoms or ions has three unpaired electrons?

A. N
B. Al
C. S^{2-}
D. Ti^{2+}

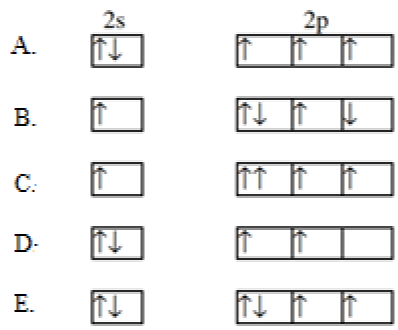
9. The electron configuration for the carbon atom is:

A. $1s^2 2s^2 2p^2$
B. $[He]2s^4$
C. $[Ne]2s^2 2p^2$
D. $1s^2 2p^4$

10. An element has the electron configuration $[Kr]5s^2 4d^{10} 5p^2$. The element is a(n)

A. nonmetal
B. transition metal
C. metal
D. lanthanide

Nitrogen has five valence electrons. Consider the following electron arrangements when answering 11 and 12:



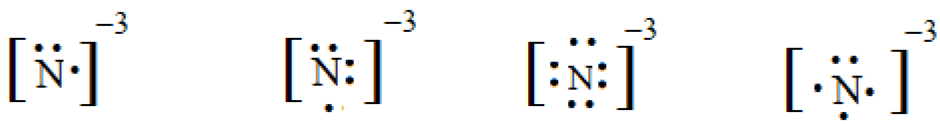
11. Using the choices in the adjacent drawing which represents the ground state for N^{1+}?

A. B. C. D. E.

12. Using the choices in the adjacent drawing which represents the ground state for N?

A. B. C. D. E.

13. Which is the correct dot diagram for N^{3-} ion?



A. B. C. D.

14. A sample of a hydrocarbon (containing only hydrogen and carbon) is completely combusted in air. The only products of the reaction are 220 g CO_2 and 45 g H_2O. What is the <u>empirical formula</u> of the hydrocarbon?

A. CH B. CH_2 C. C_2H_3 D. C_3H_4 E. C_3H_8

15. Which of the following lists the atoms in order of decreasing first ionization energy?

A. Li > O > N > F
B. Li > N > O > F
C. F > O > N > Li
D. Na > Sr > O > F

16. Which of the following statements is **<u>false</u>**?

A. A sodium atom has a smaller radius that a potassium atom
B. Neon atoms have a smaller radius than argon atoms
C. A fluorine atom has a smaller first ionization energy than an oxygen atom
D. A cesium atom has a smaller first ionization energy than a lithium atom

Use the Specific Heat table below to answer questions 17 and 18.

Substance	C (J/g °C)
Air	1.01
Aluminum	0.902
Copper	0.385
Gold	0.129
Iron	0.450
Mercury	0.140
NaCl	0.864
Ice	2.03
Water	4.18

17. A piece of aluminum with a mass of 100.0 g has a temperature of 20.0^{O}C. It absorbs 1100 J of heat energy. What is the final temperature of the metal?

A. 7.8 ^{O}C
B. 12.2^{O}C
C. 20.0 ^{O}C
D. 32.2 ^{O}C

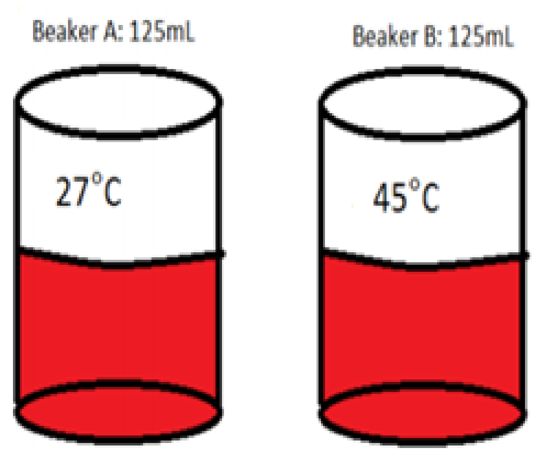
18. A 10.0 g sample of which substance would show the greatest change in temperature when absorbing 350 J of heat energy?

A. Aluminum
B. Copper
C. Gold
D. Water

Use the information in the beakers below to answer questions 19 and 20:

19. The beakers both contain the same substance. The beaker with the greater average kinetic energy is

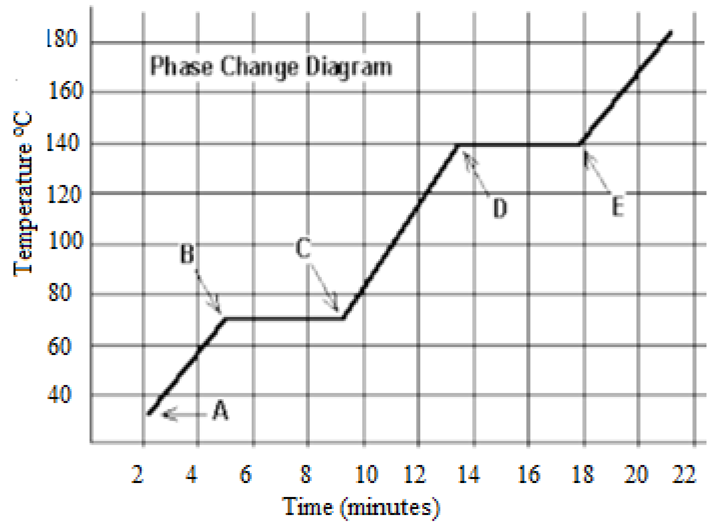
A. Beaker A
B. Beaker B
C. Both are the same
D. Cannot be determined without the density



20. A 50.0 mL ice cube (H_2O solid) at 0°C is placed inside each beaker. The **<u>greatest amount</u>** of thermal energy will GAINED by ____________________.

A. the fluid in beaker A
B. the ice cube in beaker A
C. the fluid in beaker B
D. the ice cube in beaker B

21. The diagram below shows the heating of an unknown substance. Its melting point is_______.
A. between 35ºC and 70ºC
B. 70ºC
C. between 70ºC and 140ºC
D. 140ºC



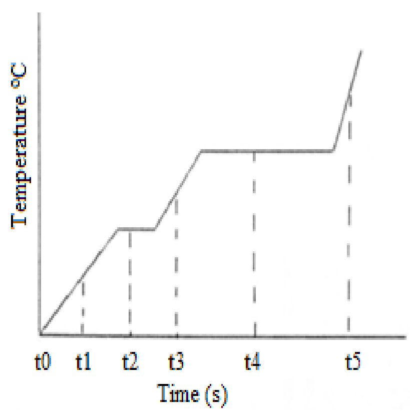
22. Using the data below, what is the order of changes that occur when ethanol is heated from -25.0ºC to 85.0ºC?

Boiling point of ethanol: 78.5ºC
Melting point of ethanol: -117.3ºC

A. Phase change, temperature change
B. Phase change, temperature change, phase change
C. Temperature change, phase change
D. Temperature change, phase change, temperature change

Use the graph and table of constants for water below to answer 23-25

23. At what time is the average kinetic energy the greatest?
A. t_1
B. t_2
C. t_3
D. t_4
E. t_5



Specific heat of ice	2.1 J/g°C
Specific heat of water	4.18 J/g°C
Specific heat of steam	2.0 J/g°C
Molar heat of fusion	6.02 kJ/mol
Molar heat of vaporization	40.7 kJ/mol

24. A 48.0 g sample of ice at 0°C absorbs 6400 J of heat energy. After the heat is applied, the sample is now: A and C both correct since not enough heat to melt all of the ice.
A. still a solid
C. a liquid
B. is melting
D. is boiling

25. How much energy is required to boil 10.0 g of water which is at 100°C?
A. 10.0 kJ
C. 40.7 kJ
B. 22.6 kJ
D. 407 kJ

Periodic Table and Chemistry Formulae Updated 3-12-2018

Periodic Table of the Elements
amu to 4 significant figures

1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Ds** (281)	111 **Rg** (272)	112 **Cn** (285)	113 (Uut) (284)	114 **Fl** (289)	115 (Uup) (288)	116 **Lv** (293)	117 (Uus) (294)	118 (Uuo) (294)

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0	**Lanthanide Series**
90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)	**Actinide Series**

CHEMISTRY FORMULAS

GASES, LIQUIDS, SOLUTIONS

PV = nRT

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

$$P_A = P_{total} \bullet X_A$$

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

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

Kelvin = °C + 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 = $\frac{\text{moles solute}}{\text{liter of solution}}$

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
Keq = equilibrium constant

R, Gas constant = $\frac{8.31 \text{ Joules}}{\text{Mole Kelvin}}$

$= \frac{0.0821 \text{ liter atm}}{\text{mole Kelvin}}$

$= \frac{8.31 \text{ volts coulombs}}{\text{mole Kelvin}}$

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 °C, 1.00 atm (101.3 kPa = 760 mm of Hg = 760 Torr) = 14.7 psi

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

°C x 9/5 + 32 = °F
(°F - 32) x 5/9 = °C

ATOMIC STRUCTURE

$\Delta E = h\nu$

$c = \nu\lambda$

$\lambda = \dfrac{h}{mv}$

$p = mv$

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

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

where a B + b B ↔ c C + d D

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

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

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

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

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

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

$K_a \times K_b = K_w$ at 25°C

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

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

Δn = moles product gas – moles reactant gas

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

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

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

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

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

$q = mC\Delta T$

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

$q = mH_f$

$q = mH_v$.

$\Delta U = \Delta H - P\Delta V$

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

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

Water $H_f = \dfrac{330 \text{ joules}}{\text{gram}}$

Water $H_v = \dfrac{2260 \text{ joules}}{\text{gram}}$

ΔU = change internal energy of a system
ΔH= change in energy of a system
-PΔV = work of gases
1liter-atm = 101.325 J

Metal Activity Series

Metal	Metal Ion
Li	Li^{+1}
K	K^{+1}
Ba	Ba^{+2}
Ca	Ca^{+2}
Na	Na^{+1}
Mg	Mg^{+2}
Al	Al^{+3}
Mn	Mn^{+2}
Zn	Zn^{+2}
Cr	Cr^{+3}
Fe	Fe^{+2}
Co	Co^{+2}
Ni	Ni^{+2}
Sn	Sn^{+2}
Pb	Pb^{+2}
H_2	2 H^{+1}
Cu	Cu^{+2}
Ag	Ag^{+1}
Hg	Hg^{+2}
Pt	Pt^{+2}
Au	Au^{+3}

Chemistry I Answer Key PINK TEST Corrections
Date: February 2018

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

CHEMISTRY 1 For Honor's, Enriched or College Prep. Not for AP or Second year students. 25 multiple choice questions per exam. Try to include drawings, lab data, and graphs on each test.

All questions deal with the applications of chemical concepts not just memorization of ideas or steps.

January Test: scientific method, measurement, factor label conversions, properties, graphing, mixtures, compounds, formulas, mole, weight percent, chemical reactions, using the metal and non-metal activity series for writing chemical reactions, types of reactions, stoichiometry, atomic structure and history which includes alpha, beta, gamma radiation, but not electronic configuration.

February Test: Quantum Theory, Electronic structure, orbital notation, dot notation, Coulomb's Law, periodic behavior, specific heat, heat of phase changes, molar heat of fusion, molar heat of vaporization, graphs of phase changes, plus January topics Review.

March Test: Chemical bonding, molecular structure, simple isomers, intermolecular attractions, redox but not balancing redox equations, kinetic theory, solids, liquids, gases, gas laws, gas Stoichiometry, mole fraction as applied to gases, plus January and February topics Review.

April Test: solutions, use of solubility rules, reaction rates, chemical equilibrium, entropy, reaction spontaneity, Keq, acids, bases, salts, net ionic equations, thermo chemistry, ΔH, Hess's law, radioactive decay reactions, plus January, February, and March topics Review.

Dates for 2018 Season

Thursday February 8, 2018

Thursday March 8, 2018 Thursday April 12, 2018

All areas and schools must complete the April exam and mail in the results by April 28th, 2018

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: http://entnet.com/~personal/njscil/html/

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 2019 Season

Thursday January 10, 2019 Thursday February 7, 2019

Thursday March 7, 2019 Thursday April 11, 2019

New Jersey Science League – Chemistry I Exam
March 8, 2018 PINK TEST Corrections:

Choose the answer that best completes the statement or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. You may use the given periodic table and formula sheet as well as a calculator. On the formula sheets is a table of the activity series of the elements. Please PRINT your name, school, area and which test you are taking on to the scan-tron.

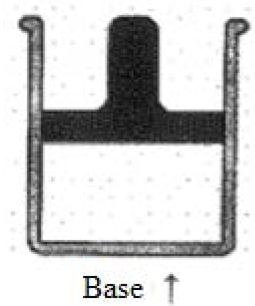
1. What is the mass in grams of 5 copper atoms?
   a. 317.8 g
   b. 7.65×10^{-24}g
   c. 6.022×10^{23}g
   d. 5.28×10^{-22}g

2. A chloride of rhenium (#75) contains 63.6% rhenium. What is the formula of this compound?
   a. ReCl
   b. $ReCl_3$
   c. $ReCl_5$
   d. Re_2Cl_3

3. Nitric oxide, NO, is made from a reaction between ammonia and oxygen as follows:
   $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
   What mass in grams of NO can be produced from 6.82 g of NH_3?
   a. 3.87 g
   b. 12.0 g
   c. 6.82 g
   d. 18.0 g

4. In the following balanced equation, chlorine is
   $2Cs_{(s)} + Cl_{2(g)} \rightarrow 2CsCl_{(s)}$
   a. The reducing agent
   b. The oxidizing agent
   c. Oxidized
   d. The electron donor

5. A sample of helium gas is placed in a container fitted with a piston as pictured below. Which process will cause the piston to move away from the base?
   a. Heating the helium
   b. Removing some of the helium from the container
   c. Turning the container on its side
   d. All of the above



6. Calculate the density of molecular nitrogen gas at STP.
   a. 0.625 g/L
   b. 0.800 g/L
   c. 1.25 g/L
   d. 1.60 g/L

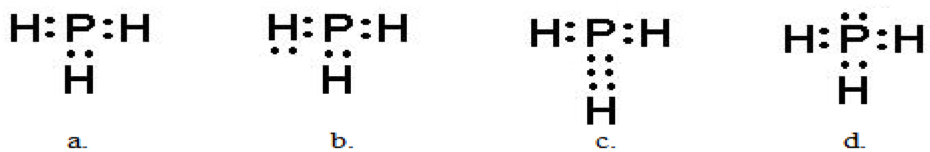
7. What would happen to the average kinetic energy of the molecules of a gas sample if the temperature was increased from 20°C to 40°C?
   a. It would double
   b. It would increase
   c. It would become half the original value
   d. It would decrease
   e. Two of these

8. Which of the following sets of elements is arranged in order of <u>decreasing</u> <u>electronegativity</u>?
   a. Cl, S, Se
   b. F, B, O
   c. Br, Cl, S
   d. Be, C, N

9. Which of the following BEST explains the relatively low melting point of covalent molecular substances?
   a. Covalent molecular materials rely on weak electrostatic forces holding the ions together.
   b. The "sea" of electrons between the atoms creates relatively weak bonding
   c. The intermolecular forces between the molecules are weak compared to ionic or covalent bonds.
   d. The similar electronegativity of the atoms causes repulsions between the molecules

10. How many hydrogen atoms must bond to silicon to give it an octet of valence electrons?
   a. 1
   b. 2
   c. 3
   d. 4

11. Which of the following correctly represents the Lewis structure for PH_3?



12. Which of the following is <u>most volatile</u>?

H_2O NH_3 CH_4

   a. H_2O
   b. NH_3
   c. CH_4
   d. none of the above are volatile

13. Vaporization is
   a. endothermic
   b. exothermic
   c. isothermic
   d. metaphysical

14. What is the volume, in liters, occupied by 1.73 moles of N_2 gas at 0.992 atm pressure and temperature of 75º C?
   a. 10.7 L
   b. 33.8 L
   c. 49.8 L
   d. 52.2 L

15. On a cold winter day, a steel hand rail feels colder than a wooden hand rail of identical size. The best explanation for this observation is: All full credit. No ans are correct. C of steel is about 0.49j/gC while wood is 1.7 j/gC. The concept is energy transfer. Steel transfers heat faster than wood.

   a. the specific heat capacity of steel is higher than the specific heat capacity of wood
   b. the specific heat capacity of steel is lower than the specific heat capacity of wood
   c. Steel has a better ability to resist changes in temperature than wood
   d. the mass of the steel is less than the mass of the wood

16. When an excited electron in an atom moves from the ground state, the electron
   a. absorbs energy as it moves to a higher energy state.
   b. absorbs energy as it moves to a lower energy state.
   c. emits energy as it moves to a higher energy state.

d. emits energy as it moves to a lower energy state.

17. Which of the following statements about intermolecular forces is <u>incorrect</u>?
   a. They must be overcome in order for molecules to escape from the liquid state into the vapor state.
   b. They are much weaker than intramolecular forces
   c. They are electrostatic in origin.
   d. They occur within molecules rather than between molecules

18. A gaseous mixture at a total pressure of 1.50 atm contains equal molar amounts of He, Ne, and Ar. At constant temperature CO_2 gas is added to the mixture until the total pressure is 3.00 atm. Which of the following is a correct statement concerning partial pressures after the CO_2 addition?
   a. The partial pressure of Ar has doubled.
   b. The partial pressure of CO_2 is three times that of Ne.
   c. All four gases have equal partial pressures.
   d. The partial pressure of He, Ne and Ar are each cut in half

19. Why does the air pressure inside the tires of a car <u>increase</u> when the car is driven?
   a. Some of the air has leaked out
   b. The air particles collide with the tire after the car is in motion
   c. The air particles inside the tire increase their speed because their temperature rises
   d. The atmosphere compresses the tire

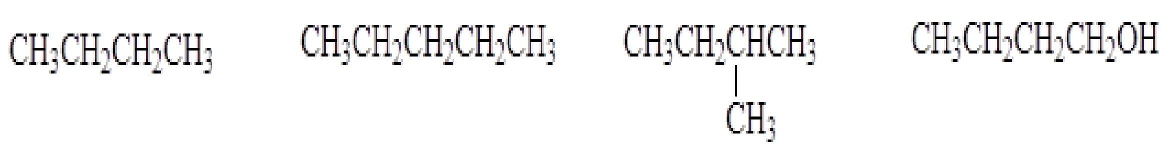
20. Quicklime, CaO, is produced by the thermal decomposition of calcium carbonate, $CaCO_3$. The balanced reaction is as follows:

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$$

Calculate the volume in liters of CO_2 at STP produced when 152 g of $CaCO_3$ is decomposed.

a. 34.0 L	c. 66.9 L
b. 22.4 L	d. 100 L

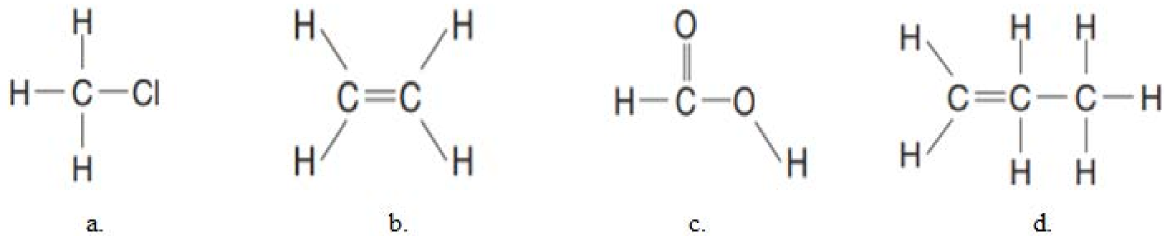
21. Arrange the following compounds in decreasing freezing point order from **<u>highest to lowest</u>**. The freezing pt. of the following compounds is expected to decrease in this order



I II III IV

a. I > II > III > IV	c. III > II > IV > I
b. III > I > II > IV	d. IV > II > III > I

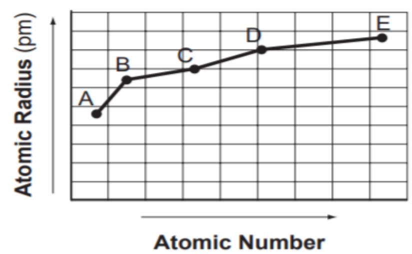
22. Which structural formula is <u>incorrect</u>?



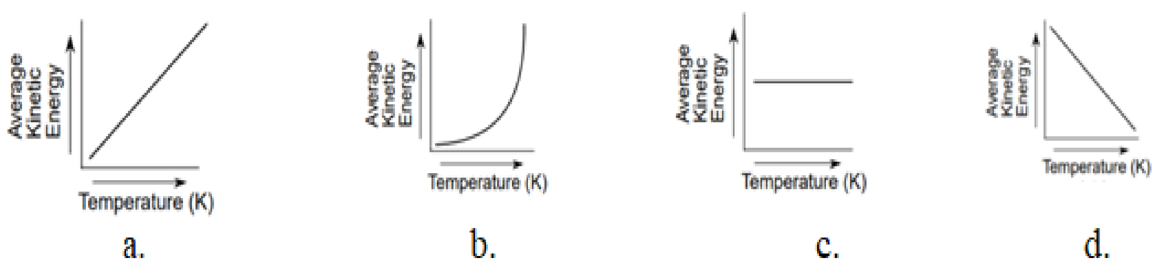
23. The graph below represents the relationship between atomic radii, in picometers, and increasing atomic number for elements in Group 15 (5A).

Which element is <u>most metallic</u>?

a. A
b. B
c. D
d. E

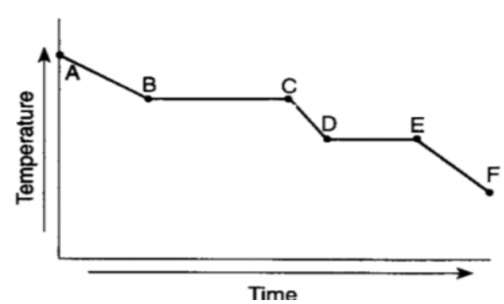


24. Which graph best shows the relationship between Kelvin temperature and average kinetic energy?



25. The graph below represents the uniform cooling of a substance, starting in the gaseous phase. During which interval are the particles in the substance only in the liquid state?

a. AB b. BC c. CD d. DE



Periodic Table and Chemistry Formulae Updated 3-12-2018

Periodic Table of the Elements
amu to 4 significant figures

1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Ds** (281)	111 **Rg** (272)	112 **Cn** (285)	113 (Uut) (284)	114 **Fl** (289)	115 (Uup) (288)	116 **Lv** (293)	117 (Uus) (294)	118 (Uuo) (294)

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0	**Lanthanide Series**
90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)	**Actinide Series**

CHEMISTRY FORMULAS

GASES, LIQUIDS, SOLUTIONS

$$PV = nRT$$

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

$$P_A = P_{total} \bullet X_A$$

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

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

Kelvin = °C + 273

$$P_1 V_1 = P_2 V_2$$

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

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

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

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

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

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

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

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

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
Keq = equilibrium constant

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 °C, 1.00 atm (101.3 kPa = 760 mm of Hg = 760 Torr) = 14.7 psi

1 faraday ℑ = 96,500 coulombs/ mole of electrons

°C x 9/5 + 32 = °F
(°F - 32) x 5/9 = °C

ATOMIC STRUCTURE

$\Delta E = h\nu$

$c = \nu\lambda$

$\lambda = \dfrac{h}{mv}$

$p = mv$

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

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

where a B + b B ↔ c C + d D

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

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

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

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

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

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

$K_a \times K_b = K_w$ at 25°C

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

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

Δn = moles product gas – moles reactant gas

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

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

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

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

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

$q = mC\Delta T$

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

$q = mH_f$

$q = mH_v$.

$\Delta U = \Delta H - P\Delta V$

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

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

Water $H_f = \dfrac{330 \text{ joules}}{\text{gram}}$

Water $H_v = \dfrac{2260 \text{ joules}}{\text{gram}}$

ΔU = change internal energy of a system
ΔH= change in energy of a system
-PΔV = work of gases
1liter-atm = 101.325 J

Metal Activity Series	
Metal	Metal Ion
Li	Li^{+1}
K	K^{+1}
Ba	Ba^{+2}
Ca	Ca^{+2}
Na	Na^{+1}
Mg	Mg^{+2}
Al	Al^{+3}
Mn	Mn^{+2}
Zn	Zn^{+2}
Cr	Cr^{+3}
Fe	Fe^{+2}
Co	Co^{+2}
Ni	Ni^{+2}
Sn	Sn^{+2}
Pb	Pb^{+2}
H_2	$2\ H^{+1}$
Cu	Cu^{+2}
Ag	Ag^{+1}
Hg	Hg^{+2}
Pt	Pt^{+2}
Au	Au^{+3}

<u>Chemistry I Answer Key</u> PINK TEST

Date: March 8, 2018 Corrections

Deadline: All March exam results must be post marked by March 16th or scan the record sheet and email to newjsl@ptd.net or the scores will not count.

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

CHEMISTRY 1 <u>For Honor's, Enriched or College Prep. Not for AP or Second year students.</u> 25 multiple choice questions per exam. Try to include drawings, lab data, and graphs on each test.

<u>All questions deal with the applications of chemical concepts not just memorization of ideas or steps</u>.

<u>January Test</u>: scientific method, measurement, factor label conversions, properties, graphing, mixtures, compounds, formulas, mole, weight percent, chemical reactions, using the metal and non-metal activity series for writing chemical reactions, types of reactions, stoichiometry, atomic structure and history which includes alpha, beta, gamma radiation, but not electronic configuration.

<u>February Test</u>: Quantum Theory, Electronic structure, orbital notation, dot notation, Coulomb's Law, periodic behavior, specific heat, heat of phase changes, molar heat of fusion, molar heat of vaporization, graphs of phase changes, plus January topics Review.

<u>March Test</u>: Chemical bonding, molecular structure, simple isomers, intermolecular attractions, redox but not balancing redox equations, kinetic theory, solids, liquids, gases, gas laws, gas Stoichiometry, mole fraction as applied to gases, plus January and February topics Review.

<u>April Test</u>: solutions, use of solubility rules, reaction rates, chemical equilibrium, entropy, reaction spontaneity, Keq, acids, bases, salts, net ionic equations, thermo chemistry, ΔH, Hess's law, radioactive decay reactions, plus January, February, and March topics Review.

Dates 2018 Season

Thursday March 8, 2018 Thursday April 12, 2018

All areas and schools must complete the April exam and mail in the results by April 28th, 2017

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: **http://entnet.com/~personal/njscil/html/**

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.

New Jersey Science League – Chemistry I Exam No Corrections
APRIL 12, 2018 PINK TEST

Choose the answer that best completes the statement or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. You may use the given periodic table and formula sheet as well as a calculator. On the formula sheets is a table of the activity series of the elements. Please PRINT your name, school, area and which test you are taking on to the scan-tron.

1. If the density of an unknown gas Z is 4.50 g/L at STP, what is the molar mass of gas Z?
a. 0.201 g/mol c. 26.9 g/mol
b. 5.00 g/mol d. 101 g/mol

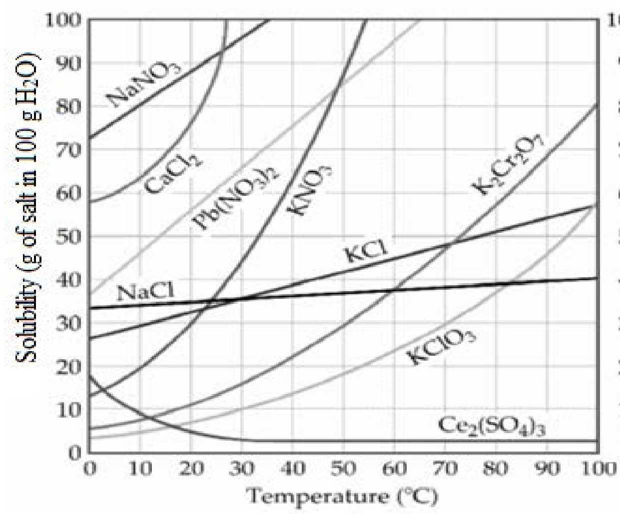
2. What volume of air is needed to completely burn 1.0 mole of propane (C_3H_8) at STP. Assume that the air is composed of 21.0% by volume O_2

C_3H_8 + $5O_2$ → 3 CO_2 + 4 H_2O

a. 112 L c. 533 L
b. 23.5 L d. 22.4 L

3. A 50.0 gram sample of potassium chlorate is dissolved in 200 g of water at 100 °C. The solution is cooled to 30.0 °C . Using the graph below determine how many grams of precipitate will form?

a. 10 g
b. 30 g
c. 20 g
d. 40 g



4. A student is assigned the task of determining the number of moles of water in one mole of $MgCl_2$•n H_2O. The student collects the data shown in the following table.
Determine the value of n.

Mass of empty container	20.676 g
Initial mass of sample + container	25.825 g
Mass of sample and container after heating	24.411 g

a. 2 c. 4
b. 3 d. 5

5. A mixture of $KClO_3$ and KCl is heated and the $KClO_3$ decomposes according to the following equation:

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

The following data was obtained:

Mass of mixture before heating	5.238 g
Mass of mixture after heating	3.972 g

Calculate the percent of $KClO_3$ in the mixture.

a. 61.7%
c. 75.8%
b. 24.2%
d. 72.0%

6. Water has quite a few unusual properties. Which of the following is **not** one of the properties of water at room temperature?

a. Water is a liquid at room temperature, unlike most compounds with similar molecular weights.
b. The density of solid water is greater than the density of liquid water
c. Water has a high heat capacity or specific heat
d. Water is a universal solvent, capable of dissolving many different compounds

7. A vinegar solution reads 8% (v/v) acetic acid. What does this mean in terms of concentration of acetic acid?

a. 8 mL of pure acetic acid in every 100 mL of solution
b. 8 g of pure acetic acid in every 100 mL of acetic acid
c. 8 mL of pure water in every 100 mL of acetic acid
d. 8 mL of pure acetic acid in every 100 mL of solvent

8. Which gas sample will occupy the most volume at STP?

a. 2.0 mol of NH_3
c. 4.0 mol of O_2
b. 3.0 mol of H_2
d. 1.0 mol of CO_2

9. 2.0 mol of $Ba(NO_3)_2$ contains ___ mol of oxygen atoms

a. 12.0
c. 6.0
b. 3.0
d. 2.0

10. 10.0g of a metallic element is found to contain 0.4113 mol of that element. Which metal must it be?

a. Mg
c. Ca
b. K
d. Cs

11. Which of the following 0.20M solutions will **not** form a precipitate when mixed with an equal volume of 0.20M $Sr(OH)_2$?

a. CaS
c. NH_4Cl
b. Na_2SO_4
d. $Ba(NO_3)_2$

12. Consider the following reaction: $2Al_{(s)} + 6HCl_{(aq)} \rightarrow 2AlCl_{3(aq)} + 3H_{2(g)}$

A 0.040 mole piece of aluminum reacted completely in 20 s. The rate of formation of hydrogen gas is:

a. 0.0013 mol/s
c. 0.0020 mol/s
b. 0.0030 mol/s
d. 0.0060 mol/s

13. Consider the following reaction:

$$2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(l)}$$

What is the equilibrium constant expression for the reaction?

a. $Keq = [H_2]^2[O_2]$

c. $Keq = \frac{[H_2O]^2}{[H_2]^2[O_2]}$

b. $Keq = \frac{[H_2]^2[O_2]}{[H_2O]^2}$

d. $Keq = \frac{1}{[H_2]^2[O_2]}$

14. For the following reaction, which of the following is a conjugate acid-base pair?

$$HC_2O_4^-{}_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+{}_{(aq)} + C_2O_4^{2-}{}_{(aq)}$$

a. $HC_2O_4^-$ and H_2O

b. $HC_2O_4^-$ and H_3O^+

c. H_2O and $C_2O_4^{2-}$

d. $HC_2O_4^-$ and $C_2O_4^{2-}$

15. The equilibrium constant for the gas phase reaction

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

is *Keq* = 230 at 300^o C. At 300^{o}C which one of the following statements is true at equilibrium?

a. The reactant predominates.
b. The products predominate.
c. Only products are present.
d. Only the reactant is present.

16. Which of the following processes should have $\Delta S < 0$?

a. $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$
b. $H_2O_{(l)} \rightarrow H_2O_{(g)}$
c. $2\ NO_{2(g)} \rightarrow N_2O_{4(g)}$
d. $NaCl_{(s)} + H_2O_{(l)} \rightarrow NaCl_{(aq)}$

17. The combustion of methane can be written as $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + heat. Which of the following statements best describes this process?

a. It is endothermic because it absorbs heat.
b. It is endothermic because it releases heat.
c. It is exothermic because it absorbs heat.
d. It is exothermic because it releases heat

18. Sodium reacts violently with water according to the equation below.

$$2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$$

The resulting solution has a higher temperature than the water prior to the addition of sodium. What are the signs of ΔH° and ΔS° for this reaction?

a. ΔH° is negative and ΔS° is negative
b. ΔH° is positive and ΔS° is negative
c. ΔH° is negative and ΔS° is positive
d. ΔH° is positive and ΔS° is positive

19. The balanced **net ionic equation** for precipitation of $CaCO_3$ when aqueous solutions of Na_2CO_3 and $CaCl_2$ are mixed is ___________.

a. $2Na^+_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow Na_2CO_{3(aq)}$
b. $2Na^+_{(aq)} + 2Cl^-_{(aq)} \rightarrow 2NaCl_{(aq)}$
c. $Na^+_{(aq)} + Cl^-_{(aq)} \rightarrow NaCl_{(aq)}$
d. $Ca^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow CaCO_{3(s)}$

20. What is the energy required to evaporate two moles of liquid water given the following equations?

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(g) \qquad \Delta H = -483.6\ kJ$$
$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l) \qquad \Delta H = -571.6\ kJ$$

a. 44.0 kJ b. 88.0 kJ c. 527.6 kJ d. 1055.2 kJ

21. What is the ΔH value for an exothermic energy change?

a. Always negative
b. Always positive
c. Could be positive or negative
d. Depends on the potential energy of the reactants

22. Which of the following statements is true?

a. In an endothermic process heat is transferred from the surroundings to the system.
b. In an exothermic process heat is transferred from the surroundings to the system.
c. The surroundings will feel cooler in an exothermic process.
d. The surroundings will feel warmer in an endothermic process.

23. ^{99}Mo decays to form ^{99}Tc. The type of radioactive decay observed is

a. a neutron c. an alpha particles
b. a beta particle d. a gamma particle

24. In which of the following pairs of substances are both members of the pair *salts*?

a. H_2SO_4 and $BaSO_4$
b. NaCl and NaOH
c. $BaBr_2$ and KCl
d. HNO_3 and KOH

25. In a particular reaction between copper and silver, 12.7 g Cu produces 38.1 g Ag. What is the percent yield of silver in this reaction?

$$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2\ Ag$$

a. 56.7 % c. 88.2%
b. 77.3 % d. 176%

Periodic Table and Chemistry Formulae Updated 3-12-2018

Periodic Table of the Elements
amu to 4 significant figures

1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Ds** (281)	111 **Rg** (272)	112 **Cn** (285)	113 (Uut) (284)	114 **Fl** (289)	115 (Uup) (288)	116 **Lv** (293)	117 (Uus) (294)	118 (Uuo) (294)

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0	**Lanthanide Series**
90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)	**Actinide Series**

CHEMISTRY FORMULAS

GASES, LIQUIDS, SOLUTIONS

$PV = nRT$

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

$P_A = P_{total} \bullet X_A$

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

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

Kelvin = °C + 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 = $\frac{\text{moles solute}}{\text{liter of solution}}$

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
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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
Keq = equilibrium constant

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 °C, 1.00 atm (101.3 kPa = 760 mm of Hg = 760 Torr) = 14.7 psi

1 faraday ℑ = 96,500 coulombs/ mole of electrons

°C x 9/5 + 32 = °F
(°F - 32) x 5/9 = °C

ATOMIC STRUCTURE

$\Delta E = h\nu$

$c = \nu\lambda$

$\lambda = \frac{h}{mv}$

$p = mv$

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

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

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

$pH + pOH = 14$

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

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

$K_a \times K_b = K_w$ at 25°C

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

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

Δn = moles product gas – moles reactant gas

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

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

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

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

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

$q = mC\Delta T$

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

$q = mH_f$

$q = mH_v$.

$\Delta U = \Delta H - P\Delta V$

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

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

Water $H_f = \frac{330 \text{ joules}}{\text{gram}}$

Water $H_v = \frac{2260 \text{ joules}}{\text{gram}}$

ΔU = change internal energy of a system
ΔH= change in energy of a system
$-P\Delta V$ = work of gases
1liter-atm = 101.325 J

Metal Activity Series

Metal	Metal Ion
Li	Li^{+1}
K	K^{+1}
Ba	Ba^{+2}
Ca	Ca^{+2}
Na	Na^{+1}
Mg	Mg^{+2}
Al	Al^{+3}
Mn	Mn^{+2}
Zn	Zn^{+2}
Cr	Cr^{+3}
Fe	Fe^{+2}
Co	Co^{+2}
Ni	Ni^{+2}
Sn	Sn^{+2}
Pb	Pb^{+2}
H_2	2 H^{+1}
Cu	Cu^{+2}
Ag	Ag^{+1}
Hg	Hg^{+2}
Pt	Pt^{+2}
Au	Au^{+3}

Chemistry I Answer Key PINK TEST No Corrections

Date: April 2018

All schools and areas must finish the April exam and post mark or scan all results by April 30th.

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

CHEMISTRY I (No AP or second year students in this category.)

CHEMISTRY 1 For Honor's, Enriched or College Prep. Not for AP or Second year students. 25 multiple choice questions per exam. Try to include drawings, lab data, and graphs on each test.

All questions deal with the applications of chemical concepts not just memorization of ideas or steps.

January Test: scientific method, measurement, factor label conversions, properties, graphing, mixtures, compounds, formulas, mole, weight percent, chemical reactions, using the metal and non-metal activity series for writing chemical reactions, types of reactions, stoichiometry, atomic structure and history which includes alpha, beta, gamma radiation, but not electronic configuration.

February Test: Quantum Theory, Electronic structure, orbital notation, dot notation, Coulomb's Law, periodic behavior, specific heat, heat of phase changes, molar heat of fusion, molar heat of vaporization, graphs of phase changes, plus January topics Review.

March Test: Chemical bonding, molecular structure, simple isomers, intermolecular attractions, redox but not balancing redox equations, kinetic theory, solids, liquids, gases, gas laws, gas Stoichiometry, mole fraction as applied to gases, plus January and February topics Review.

April Test: solutions, use of solubility rules, reaction rates, chemical equilibrium, entropy, reaction spontaneity, Keq, acids, bases, salts, net ionic equations, thermo chemistry, ΔH, Hess's law, radioactive decay reactions, plus January, February, and March topics Review.

Dates 2018 Season

Thursday April 12, 2018

All schools and areas must finish the April exam and post mark or scan all results by April 30th.

New Jersey Science League

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Web address: **http://entnet.com/~personal/njscil/html/**

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 2019 Season

Thursday January 10, 2019 Thursday February 14, 2019
Thursday March 14, 2019 Thursday April 11, 2019