Round to 1's place.

AP Chemistry Final Exam Review **Name** Key 2010

PART 1: MULTIPLE CHOICE: CALCULATORS ARE NOT ALLOWED!

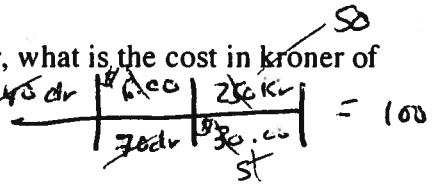
C 1. When 215 g of potassium nitrate, 0.35 g of sodium chloride and 500.0 g of water mixed at about 90°C, 585.3 mL of solution are obtained. The density of this solution in g/mL to the correct significant figures is:

215g + .35 + 500 = 585.3 mL

a. 1 b. 1.2 c. 1.22 d. 1.222 e. 1.22193

C 2. If \$6.00 = 70. drachma and approximately \$30.00 = 250 kroner, what is the cost in kroner of an item priced at 140 drachma.

a. 2.0 b. 6.0 c. 1.0×10^2 d. 1.0×10^5



B 3. The solubility of potassium nitrate at 25°C is 36 g/100 g water. If a solution of 22 g of potassium nitrate in 50.0 g of water is cooled to 25°C, then how many grams of potassium nitrate would not be able to dissolve?

a. 8.0 g b. 4.0 g c. 11 g d. 18 g

22 - 18 = 4

25°C: 36 g / 100 g H2O = 18 g / 50 g H2O

C 4. A certain substance has a solubility of 21.30 g per 100.0 g of water. The same substance's solubility, when expressed in kg/kg of water is:

a. 0.0469 b. 0.0004696 c. 0.2130 d. 21.30

$\frac{21.30\ kg}{100.0\ kg}$

E 5. Fluorine has the nuclear symbol $^{19}_{9}F$. The total number of subatomic particles (neutrons + protons,+ electrons) in a fluorine atom is:

a. 9 b. 10 c. 18 d. 19 e. 28

$9p^+ + 9e^- + 10n^0$

C 6. The combination of numbers and symbols in 5 N_2 stands for:

a. 5 nitrogen atoms
b. 10 separate nitrogen atoms
c. 5 nitrogen molecules
d. 10 nitrogen molecules
e. none of those

C 7. Consider the following statements

I. A mole of copper has more atoms than a mole of silver. F
II. A mole of silver has a greater mass than a mole of copper. T
III. Both gold and silver have a generic valence configuration of $ns^2(n-1)d^9$. F
IV. A silver ion has more protons than electrons. T

ns^1 d^{10}

The number of true statements above is . . .

a. 0 b. 1 c. 2 d. 3 e. 4

C 8. Copper (II) oxide reacts with hydrogen gas, producing copper metal and water. The correct form of the chemical equation that describes this reaction is:

a. $Cu_2O(s) + H_2(g) \rightarrow 2Cu(s) + H_2O(\ell)$
b. $Cu_2O(s) + 2H\ (g) \rightarrow 2Cu(s) + H_2O(\ell)$
c. $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(\ell)$
d. $CuO(s) + 2H\ (g) \rightarrow Cu(s) + H_2O(\ell)$
e. None of the equations above are correct.

C 9. How many grams of copper could one theoretically obtain from one gram of copper fluorosilicate Cu_2SiF_6? (MM = 269.1 g/mol)

a. 2(269.1)/63.5
b. (63.5)(269.1)
c. 2(63.5)/(269.1)
d. (269.1)/(2)(63.5)

$1g\ Cu_2SiF_6 \left| \frac{1\ mol\ Cu_2SiF_6}{269.1\ g} \right| \frac{2\ mol\ Cu}{1\ mol\ Cu_2SiF_6} \left| \frac{63.5}{1\ mol\ Cu} \right.$

D 10. The atomic mass of chlorine is 35.453. Chlorine consists of two isotopes: ^{35}Cl which has a mass of 34.969 amu, and ^{37}Cl which has an atomic mass of 36.966 amu. Calculate the percentage of ^{35}Cl.

Cl^{35} has greatest %

$(34.969)x + 36.966(1-x) = 35.453$

a. 12.24 b. 24.47 c. 54.23 d. 75.53 e. 95.76 → Too Far

$34.969x + 36.966 - 36.966x = 35.443 \; ; \; 1.997x = 1.513 \quad x = .76$

A 11. A compound contains 29.9% C, 57.8% Cl and 13.0% O by mass. Its molar mass is 246 g/mol. Its molecular formula is: (All choices have MM = 246 g/mol)

C_3Cl_2O EM = 123

Need Calc.

a. $C_6Cl_4O_2$
b. $C_3Cl_5O_2$
c. $C_2Cl_4O_5$
d. $C_9Cl_3O_2$

$29.9\ g \left| \frac{1\ mol\ C}{12\ g\ C} \right| = 2.49\ mol\ C = (3)$

$57.8\ g\ Cl \left| \frac{1\ mol}{35.45\ g} \right| = 1.63\ mol\ Cl = (2)$

$13.0 \left| \frac{1\ mol}{16.0} \right| = .81\ mol\ O$

$\frac{.81}{.81} = 1$

B 12. Which one of the following statements about caffeine, $C_8H_{10}O_2N_4$ (MM = 194 g/mol) is NOT correct?

a. Four moles of caffeine have a mass of 776 g.
b. The simplest/empirical formula for caffeine is $C_8H_{10}O_2N_4$. → $C_4H_5ON_2$
c. Caffeine contains 28.9% nitrogen.
d. One mole of caffeine has 6.02×10^{24} hydrogen atoms.

E 13. The molecular formula of a substance:

a. is sometimes equal to its simplest formula.
b. is always a whole number multiple of its simplest formula.
c. indicates the exact number and the identities of the atoms that make up a molecule.
d. a, and b are true.
e. a, b, and c are true.

C 14. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l) \quad \Delta H = -889.1\ kJ$

$\Delta H_f^\circ\ H_2O(l) = -285.8\ kJ/mol \qquad \Delta H_f^\circ\ CO_2(g) = -393.3\ kJ/mol$

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

a. -2100.0 kJ/mole
b. -907.5 kJ/mole
c. -75.8 kJ/mole
d. 175.8 kJ/mole
e. 2100.0 kJ/mole

$[1\ mol(-393.1\ kJ/mol) + 2\ mol(-285.8\ kJ/mol)] - [\Delta H_f CH_4 + 0] = -889.1\ kJ$

$-964.7 + 889.1\ kJ = \Delta H_f CH_4$

(Calc)

C 15. A 1.96 g sample of titanium was burned in a bomb calorimeter that had a heat capacity of 9.84 kJ/°C. The temperature of the calorimeter increased from 36.84°C to 98.82°C. Calculate the amount of heat that would be released from the combustion of one mole of titanium.

a. 6.20 kJ/mole
b. 610 kJ/mole
c. 1.49 x 10^4 kJ/mole
d. 311 kJ/mole
e. 1200 kJ/mole

$q = nC\Delta T = -\left(\frac{9.84\ kJ}{°C}\right)(98.82 - 36.84)$

$= -\left|\frac{609.84}{1.96\ g} \middle| \frac{47.88\ g}{mole}\right| =$

B 16. $I_2(g) + 3Cl_2(g) \longrightarrow 2ICl_3(g)$

(NonCalc) According to the data in the table below, what is the value of $\Delta H°$ for the reaction represented above?

$\Delta H° = \sum$ Bonds Broken $- \sum$ Bonds Formed

Bond	Ave. Bond Energy (kJ/mol)
I-I	149
Cl-Cl	239
I-Cl	208

a. -860 kJ
b. -382 kJ
c. +180 kJ
d. +450 kJ
e. +1,248 kJ

$[(I-I) + 3(Cl-Cl)] - [6(I-Cl)]$

$1\,mol\left(\frac{149\ kJ}{mol}\right) + 3\,mol\left(\frac{239\ kJ}{mol}\right) - 6\,mol\left(\frac{208\ kJ}{mol}\right)$

A 17. In an endothermic reaction the change in enthalpy is + , heat is required and the heat content of the products is greater than the heat content of the reactants.

a. positive, required, greater
b. negative, released, less
c. positive, required, less
d. negative, required, greater
e. positive, released, greater

B 18. How many of the following anions are derived from strong acids?

Cl^- $C_2H_3O_2^-$ PO_4^{3-} NO_3^- CO_3^{2-}

a. 1 b. 2 c. 3 d. 4 e. 5

S N Cl Cl

Br I Cl

E 19. For the reaction: $Cu(s) + 4H^+(aq) + 2NO_3^-(aq) \rightarrow 2NO_2(g) + 2H_2O + Cu^{2+}(aq)$

(NonCalc) the element reduced and oxidized are, in that order:

a. Cu, N
b. Cu, H
c. H, O
d. H, Cu
e. N, Cu

$M_1V_1 = M_2V_2$

$(11.6M)(V_1) = (3.0M)(1.0L)$

$V = \frac{3}{12} = \frac{1}{4}L$ or 250 mL

C 20. How many milliliters of 11.6-molar HCl must be diluted to obtain 1.0 liter of 3.0-molar HCl?

a. 3.9 mL b. 35 mL c. 260 mL d. 1,000 mL e. 3,900 mL

E 21. The net ionic equation for the reaction that occurs during the titration of nitrous acid with sodium hydroxide is:

a. $HNO_2 + Na^+ + OH^- \rightarrow NaNO_2 + H_2O$

b. $HNO_2 + NaOH \rightarrow Na^+ + NO_2^- + H_2O$

c. $H^+ + OH^- \rightarrow H_2O$

d. $HNO_2 + H_2O \rightarrow NO_2^- + H_3O^+$

(e.) $HNO_2 + OH^- \rightarrow NO_2^- + H_2O$

B 22. A student wishes to prepare 2.00 liters of 0.100-molar KIO_3 (molecular weight 214 g/mole). The proper procedure is to weigh out

a. 42.8 grams of KIO_3 and add 2.00 kilograms of H_2O.

(b) 42.8 grams of KIO_3 and add H_2O until the final homogeneous solution has a volume of 2.00 liters.

c. 21.4 grams of KIO_3 and add H_2O until the final homogeneous solution has a volume of 2.00 liters.

d. 42.8 grams of KIO_3 and add 2.00 liters of H_2O.

e. 21.4 grams of KIO_3 and add 2.00 liters of H_2O.

memorize

$\frac{.100 \text{ mole}}{L} \mid \frac{2.00 L}{1} \mid \frac{214 g}{\text{mole}} =$

42.8g

E 23. How many unpaired electrons are there in an atom with the electron configuration:

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

a. 1 b. 2 c. 3 d. 4 (e. 0)

C 24. There are two very intense lines in the atomic spectrum of sodium. The wavelengths are 589.0 nm and 589.6 nm. Which line corresponds to the larger energy?

a. Energy is the same for both lines.

b. Energy is greater for the 589.0 nm line.

(c) Energy is greater for the 589.6 nm line.

d. Cannot answer because insufficient information is given.

$E = h\nu$

$c = \lambda\nu$

$E = \frac{hc}{\lambda}$

the longer the λ the smaller the Energy

B 25. A filled d sublevel and a half-filled f sublevel contain a **total** of how many electrons?

a. 11 (b. 17) c. 19 d. 24

C 26. Given the following orbital diagram

1s	2s	2p	
(↑)	(↑)	( )( )( )	= hydrogen atom - excited state
(↑↓)	(↑)	( )( )( )	= hydrogen atom - ground state
(↑↓)	( )	( )( )( )	= helium atom - ground state
(↑)	(↑)	( )( )( )	= helium atom - excited state

The number of correct orbital diagrams is:
a. 0 b. 1 c. 2 d. 3 e. 4

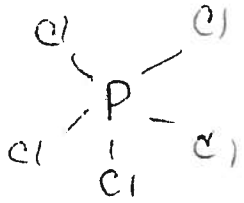
C 27. Which of the following sets of quantum numbers (n, l, m_l, m_s) best describes the valence electron of highest energy in a ground-state gallium atom (atomic number 31)?

a. 4, 0, 0, $\frac{1}{2}$
b. 4, 0, 1, $\frac{1}{2}$
c. 4, 1, 1, $\frac{1}{2}$
d. 4, 1, 2, $\frac{1}{2}$
e. 4, 2, 0, $\frac{1}{2}$

s	p	d	f
0	1	2	3

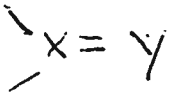
$m_e = -1, 0$ or 1

↳ $4p^1$



D 28. The total number of electron pairs around phosphorus for PCl_5 is:
a. 2 b. 3 c. 4 d. 5 e. 6

C 29. An atom X is surrounded by 3 sigma bonds and 1 pi bond. The bond angle around the central atom is:
a. 90° b. 109° c. 120° d. 180°



30. An atom X is surrounded by an unshared pair of electrons, 2 sigma bonds and one pi bond. The hybridization for the molecule with X as central atom is:
a. sp b. sp^2 c. sp^3 d. dsp^3 e. d^2sp^3

C 31. Which of the following bonds would be most polar?
a. C—C b. C—O c. C—F d. C—N

C 32. In which of the molecules below is the carbon-carbon distance the shortest?
a. C_2H_4 b. C_2H_6 c. C_2H_2 d. C_3H_8
C=C C-C C≡C C-C

D 33. Chlorine pentafluoride forms an expanded octet. Which of the following statements are true?

(1) There are 6 bonds to the central atom. F
(2) There is a pair of unshared electrons around the central atom. T
(3) Its molecular geometry is that of a square pyramid. T
(4) Its molecular geometry is tetrahedral. F

a. 1, 3 b. 2, 4 c. 1, 4 d. 2, 3

B 34. Which of the following have reasonable resonance structures?

(1) NH_3 (2) CO_3^{2-} (3) SO_2 (4) NO_2^- (5) CO

a. (1), (2), (3)
b. (2), (3), (4)
c. (3), (4), (5)
d. (2), (3)
e. (3), (5)

C 35. A sealed, rigid flask contains nitrogen gas. The flask is cooled from room temperature to -50°C. Which of the following statements is true?

a. The number of moles of nitrogen decreases. Same
b. The volume of nitrogen increases. Same
c. The pressure of nitrogen decreases.] opposite
d. The pressure of nitrogen increases.]
e. The volume of nitrogen decreases. Same

D 36. The ideal gas law predicts that:

I. the volume of a gas goes to zero at absolute zero temperature. T
II. density increases with pressure. T
III. density increases with temperature. F
IV. the product, PV/T, for a fixed amount of gas is constant. T

How many of the above statements are true?

a. 0 b. 1 c. 2 d. 3 e. 4

only 300 mL reacts.

D 37. In the equations below, carbon disulfide burns in O_2 (g) to give gaseous products.

$$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$$

100mL 500mL 100mL 200mL

If 100 mL CS_2 (g) reacts with 500 mL of O_2 (g) at standard temperature and pressure, which of the following is true at those conditions?

a. The total volume of reactants consumed is 600 mL. (400mL)
b. The total volume of products formed is 700 mL. (300mL)
c. The volume of oxygen gas left after reaction is 400 mL. (200mL)
d. The total volume of gas formed is 300 mL.
e. The total volume of gas consumed is 100 mL.

B 38. In an ideal gas, the collisions of the molecules with the walls of the container account for:

a. the velocity of the molecules.
b. the observed pressure.
c. the number of moles.
d. the observed temperature.
e. none of these

B 39. For a fixed amount of moles of gas at a fixed pressure, changing the temperature from 30K to 60K causes;

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

a. the gas volume to decrease.
b. the gas volume to double.
c. the gas volume to decrease to half its original volume.
d. no change in the gas volume.

B 40. What is the molarity of sodium chloride in solution that is 13.0 % by mass sodium choride and that has a density of 1.10 g/mL?

a. 143 M b. 2.45 M c. 2.56 M d. 2.23 M e. 0.0143 M

$$\frac{13\text{ g NaCl}}{100\text{ g solution}} \left| \frac{\text{mol NaCl}}{58.45\text{ g NaCl}} \right| \frac{1.10\text{ g solution}}{\text{mL solution}} \left| \frac{1000\text{ mL}}{\text{L}} \right| = 2.45\text{ M}$$

D 41. If you have a 1.0 molar solution of each of the following solutions, then the solution that would have the highest boiling point is

i a. glucose (1) b. NaBr (2) c. K_2SO_3 (3) d. $Fe(NO_3)_3$ (4) e. $MgCl_2$ (3)

$\Delta T = i K_b m$ Since $i = 4$

B 42. Of the following, the substance that is the most soluble in benzene(C_6H_6) is

a. PH_3 polar b. SiH_4 NP – LDF c. HBr P d. CH_3CH_2OH LDF + H-bond e. H_2O H-bond

A 43. The molar mass of a gas that has a density of 7.10 g/L at 25.0°C and 1.00 atm of pressure is

a. 174 g/mol b. 14.6 g/mol c. 28.0 g/mol d. 0.0685 g/mol e. 64.0 g/mol

$$MM = \frac{dRT}{P} = \frac{(7.10\text{ g/L})(.0821\ \frac{\text{L atm}}{\text{mol K}})(298\text{ K})}{1.00\text{ atm}} = 174\text{ g/mole}$$

D 44. Oxygen gas at a temperature of _____ and a pressure of _____ will have the greatest attraction between oxygen molecules.

a. 25 °C and 1.00 atm d. -65 °C and 30.0 atm Low Temp
b. 45 °C and 2.00 atm e. 85 °C and 2.0 atm High Pressure
c. -25 °C and 0.0050 atm

B 45. A 31.5 mL sample of H_2SO_4 solution required 23.9 mL of a 0.0134 M NaOH(aq) for neutralization. Therefore, the concentration of the sulfuric acid solution was . . .

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

a. 0.0102 M b. 0.00508 M c. 0.0204 M d. 0.00255 M e. 0.237 M

$$.0239\text{ L} \left| \frac{.0134\text{ mol B}}{\text{L B}} \right| \frac{\text{mol A}}{2\text{ mol B}} \left| \frac{11}{.0315\text{ L}} \right| = .00508\text{ M}$$

C 46. The value of ΔH° for the reaction below is -186 kJ.

$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$ $\Delta H = -186$ kJ

What is the value of the ΔH°_f for HCl(g) in kJ/mole

a. -0.037 b. -0.027 c. -93.0 d. -186 e. +186

$$\text{For } \frac{\text{kJ}}{\text{mol}} = \frac{-186\text{ kJ}}{2} =$$

c) As shown in the table below, the first ionization energies of Si, P and Cl show a trend.

Element	First Ionization Energy (kJ/mol)
Si	786
P	1,012
Cl	1,251

i) For each of the three elements, identify the quantum level (e.g. n=1, n=2, etc...) of the valence electrons in he atom.

ii) Explain the reasons for the trend in first ionization energies.

(i) All three Si, P have valence electrons in n=3.

(ii) In a period, the elements' IE increase generally in first I.E from left to right in the Periodic table. this is due to the fact that effective nuclear charge increases. For example more energy is needed to remove the $3p^5$ e- from Cl than the $3p^2$ e- from Si. However P has a greater first I.E than Si because it has a $\frac{1}{2}$ Filled 3p subleval so, it has a very even charge distribution & more energy is needed to remove the $3p^3$ e- than the $3p^2$

d) A certain element has two isotopes. The mass of one of the isotopes is 62.93amu and the mass of the other isotope is 64.93 amu.

i) Identify the element. Justify your answer.

ii) Which isotope is more abundant? Justify your answer.

(i) this element is Copper which has an Average Atomic Mass between the values of the two isotopes given

(ii) Since the average atomic mass of the isotopes of Copper is 65.39, there is a greater abundance of the isotope w/ a mass of 64.93 amu because it is closest in mass to 65.39.

AP Chemistry
Final Exam Review

Group members

Key

Directions: Work together with your group to answer each of the following questions.

1. A sample of a pure compound was found to contain 1.201 grams of carbon, 0.202 grams of hydrogen, and 7.090 grams of chlorine. What is the empirical formula of the compound?

$1.201\text{g C} \left/ \frac{\text{mol C}}{12.01\text{g}} \right. = .100\text{mol C} = 1$ $\quad 7.090\text{g Cl} \left/ \frac{\text{mol Cl}}{35.45} \right. = .200\text{mol Cl} \left/ .100 \right. = 2$

$.202\text{g H} \left/ \frac{\text{mol}}{1.01\text{g H}} \right. = .200\text{mol H} \left/ .100 \right. = 2$

CH_2Cl_2

2. A freshmen chemist analyzed a sample of copper (II) sulfate pentahydrate for water of hydration by weighing the hydrate, heating it to convert it to anhydrous copper (II) sulfate, and then weighing the anhydride. The % water was determined to be 30 %. The theoretical value was 33%. Which of the following choices is definitely NOT the cause of the error? (Exp Yield vs Act Yield)

a) After the student weighed the hydrate, a piece of rust fell from the tongs into the crucible.
b) Moisture driven from the hydrate condensed on the inside of the crucible cover before the student weighed the anhydride.
c) The original sample contained some anhydrous copper (II) sulfate.
d) The original sample was wet.

$\%H_2O = \frac{\text{mass } H_2O}{\text{mass hydrate}} \times 100 = \frac{\text{mass hydrate} - \text{mass anhydrate}}{\text{mass hydrate}}$

3. Given the following information:

Reaction 1: $H_2(g) + 1/2\,O_2(g) \leftarrow H_2O(l)$ $\quad -(\Delta H^\circ = -286\text{ kJ})$
Reaction 2: $CO_2(g) \longrightarrow C(s) + O_2(g)$ $\quad 2(\Delta H^\circ = 394\text{ kJ})$
Reaction 3: $2CO_2(g) + H_2O(l) \leftarrow C_2H_2(g) + 5/2\,O_2(g)$ $\quad \Delta H^\circ = 1300\text{ kJ}$

Find the ΔH° for the reaction $C_2H_2(g) \longrightarrow 2C(s) + H_2(g)$

$H_2O(l) \rightarrow H_2(g) + \frac{1}{2}O_2 \quad \Delta H = +286\text{ kJ}$

$2CO_2 \rightarrow 2C + 2O_2 \quad \Delta H = 788\text{ kJ}$

$C_2H_2 + 5/2\,O_2 \rightarrow 2CO_2 + H_2O \quad \Delta H = -1300\text{ kJ}$

4. The combustion of carbon monoxide yields carbon dioxide. Calculate the volume of oxygen gas (in liters) needed to produce 22 grams of carbon dioxide at STP.

$2CO + O_2 \rightarrow 2CO_2$

$22\text{g } CO_2 \left/ \frac{\text{mol } CO_2}{44\text{g } CO_2} \right. \left/ \frac{\text{mol } O_2}{2\text{mol } CO_2} \right. \left/ \frac{22.4\text{L}}{1\text{mol } O_2} \right. = 5.6\text{L}$

5. For a substance that remains a gas under the ideal conditions listed, deviation from the ideal gas law would be most pronounced at . . .

a) -100°C and 5.0 atm
b) -100°C and 1.0 atm
c) 0°C and 1.0 atm
d) 100°C and 1.0 atm
e) 100°C and 5.0 atm

(A) Highest Pressure & Lowest Temp

6. 100 grams of $O_2(g)$ and 100 grams of He(g) are in separate containers of equal volume. Both gases are at 100°C. Which of the following statement(s) is/are true?

a) Both gases have the same pressure.
b) The average kinetic energy of the O_2 molecules is greater than that of the He molecules.
c) The average kinetic energy of the He molecules is greater than that of the O_2 molecules.
d) There are equal numbers of He molecules and O_2 molecules.
e) The pressure of the He(g) would be greater than the O_2(g).

(E)

7. Which of the following series of elements is listed in order of increasing atomic radius?

a) Na, Mg, Al, Si
b) C, N, O, F
c) O, S, Se, Te
d) I, Br, Cl, F
e) K, Kr, O, Au

(C)

8. Which one of the following would have an answer with three significant digits?

a) 103.1 + 0.0024 + 0.16
b) $(3.0 \times 10^4)(5.022 \times 10^{-3})/(6.112 \times 10^2)$
c) $(4.3 \times 10^5)/(4.225 + 56.0003 - 0.8700)$
d) $(1.43 \times 10^2 + 3.1 \times 10^1)/(4.11 \times 10^{-6})$
e) $(1.41 \times 10^2 + 1.012 \times 10^4)/(3.2 \times 10^{-1})$

(D) 31 / 1170 / 1461

9. Which of the following elements most readily shows the photoelectric effect?

a) Noble gases
b) Alkali metals
c) Halogen elements
d) Transition metals
e) The chalcogen family

(B)

10. The four quantum numbers (n, l, m_l, m_s) that describe the valence electron in the cesium atom are:

a) 6, 0, -1, +1/2
b) 6, 1, -1, +1/2
c) 6, 0, 0, +1/2
d) 6, 1, 0, +1/2
e) 6, 0, 1, -1/2

(C) $6s^1$

11. A piece of metal weighing 500. grams is put into a boiling water bath. After 10 minutes, the metal is immediately placed in 250. grams of water at 40.°C. The maximum temperature that the system reaches is 50.°C. What is the specific heat of the metal? (The C_p of water is 4.184 J/g-°C)

$q_{lost} = -q_{gained}$

$T_F - T_I \quad mC\Delta T = -mC\Delta T$

$(500\text{g})C(50 - 100) = -(250\text{g})(4.184)(50 - 40)$

$C = \frac{(4.184)(10)}{100} = .4184\ \frac{J}{g^\circ C}$

12. When subjected to the flame test, a solution that contains K^+ ions produces the color _____.

a) yellow
b) violet
c) crimson
d) green
e) orange
f) white

(B)

13. A characteristic of the structure of metallic atoms is that

a) they tend to share their electrons with other atoms.
b) their atoms are smaller and more compact than those of nonmetallic elements.
c) their outermost orbital of electrons is nearly complete, and they attract electrons from other atoms.
d) the small number of electrons in their outermost orbital are weakly held and easily lost.
e) they have heavier nuclei than nonmetallic atoms.

(D)

14. What is the geometry of SiO_3^{2-}?

Trigonal Planar + Resonance

15. How many total sigma bonds are in the benzene molecule, C_6H_6?

12 sigma 3 π

16. What type of hybridization would you expect to find in BCl_3?

sp^2

17. Which of the following is most likely to dimerize? Why?

ClO_2^-, Cl_2O, ClO_2

it has odd # of e-

18. As the atomic number of the elements increases down a column,

a) the atomic radius decreases
b) the atomic mass decreases
c) the elements become less metallic
d) ionization energy decreases
e) the number of electrons in the outermost energy level increases

(D)

19. What ions would you find in solution if potassium perchlorate was dissolved in water?

a) KCl, O_2
b) K^+, Cl^-, O^{2-}
c) KCl, O^{2-}
d) K^+, ClO_4^-
e) K^+, Cl^-, O^{2-}

(D)

20. A test tube containing $CaCO_3$ is heated until all of the compound decomposes. If the test tube plus the calcium carbonate originally weighed 30.08 grams and the loss of mass during the experiment was 4.400 grams, what was the mass of the empty test tube?

$CaCO_3 \rightarrow CaO + CO_2$

So . . .
$30.08\text{g} - 16.1 = 19.48\text{g} = t.t.$
$t.t. + CaCO_3 = 30.08\text{g}$
$CO_2 = 4.400\text{ g}$
$t.t. + CaO = 25.68\text{g}$

$4.400\text{g} \left/ \frac{\text{mol } CO_2}{44\text{g}} \right. \left/ \frac{\text{mol } CaCO_3}{\text{mol } CO_2} \right. \left/ \frac{100\text{g}}{\text{mol } CaCO_3} \right. = 10.1\text{g } CaCO_3$

21. How many pi bonds are each of the following? CO_2, H_2O, SO_2, N_2

$O{=}C{=}O$ (2) (0) (1) (2)

22. Write a set of 4 quantum numbers for the highest energy valence electron in a ground state aluminum atom.

Al

Part 2 - Free Response : Solve the following.

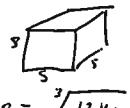
1. The density of gold is 19.3 g/cm^3. The heat capacity of gold is 0.13 J/g•°C. A cube of gold at 75.0°C is dropped into 150 g of water at 25.0°C. The final temperature of the mixture is 27.5°C. What is the length of an edge of the gold cube? (Heat capacity of H_2O = 4.184 J/g•°C)

$q_{water} = -q_{metal}$

$(150g)\left(\frac{4.184\ J}{g°C}\right)(2.5°C) = -(mass_{metal})\left(.13\ \frac{J}{g°C}\right)(-46.5°C)$

$Mass_{metal} = 260g$

$V = 260g \left|\frac{cm^3}{19.3g}\right| = 13.4cm^3$



$s = \sqrt[3]{13.4cm^3} = 2.4\ cm$

2. Answer the following questions about a pure compound that contains only carbon, hydrogen, and oxygen.

a) A 0.7549g sample of the compound burns in $O_2(g)$ to produce 1.9061g of $CO_2(g)$ and 0.3370g of $H_2O(g)$.

i) Calculate the individual masses of C, H, and O in the 0.7549g sample.

ii) Determine the empirical formula for the compound.

.7549g $C_\square H_\square O_\square$ + O_2 → 1.9061g CO_2 + .337g H_2O

$.7549g - .5198gC - .0374g\ H = .1977gO$

$1.9061g\ CO_2 \left|\frac{12gC}{44g\ CO_2}\right| = .5198gC \left|\frac{mol\ C}{12gC}\right| = .0433\ mol\ C / .0125 = 3.5$

$.3370g\ H_2O \left|\frac{2g\ H}{18g\ H_2O}\right| = .0374g\ H \left|\frac{mol\ H}{1g\ H}\right| = .0374\ mol\ H / .01235 = 3$

$.1977gO \left|\frac{mol\ O}{16g\ O}\right| = .01235\ mol\ O / .0125 = 1$

x2 =

$C_7H_6O_2$

3. Answer the following questions that related to laboratory observations and procedures.

a) An unknown gas is one of the three possible gases: nitrogen, hydrogen or oxygen. For each of the three possibilities, describe the result expected when the gas is tested using a glowing splint (a wooden stick with one end that has been ignited and extinguished, but still contains hot, glowing, partially burned wood).

* In the presence of a glowing splint the $O_2(g)$ will relight it.
* In a flaming splint the $H_2(g)$ will "pop" and
* In N_2(gas) nothing will occur. SO_2

b) The following three mixtures have been prepared: CaO plus water, SiO_2 plus water, and CO_2 plus water. For each mixture, predict if it is acidic, basic or neutral.

- $CaO + H_2O$ forms $Ca(OH)_2$ a base!
- $SiO_2 + H_2O$ will not dissolve because it is a covalent network molecule. So ∴ neutral
- $CO_2 + H_2O$ → forms H_2CO_3 and Acid!

c) Each of three beakers contains a 0.1M solution of one of the following solutions: Potassium chloride, silver nitrate or sodium sulfide. The three beakers are labeled randomly as solution 1, solution 2 and solution 3. Shown below is a partially completed table of observations made of the results of combining small amounts of different pairs of the solutions.

	$AgNO_3$ Solution 1	Na_2S Solution 2	KCl Solution 3
Na_2S → Solution 1		black precipitate	white ppt
S → Solution 2	black ppt		no reaction
Ag → Solution 3	white ppt	No Reaction	

i) Write the chemical formula of the black precipitate.
ii) Describe the expected results of mixing solution 1 & 3.
iii) Identify each of the solutions 1, 2 & 3.

(i) It is Ag_2S (Silver sulfide)

(ii) $AgNO_3 + KCl \rightarrow AgCl(s) + KNO_3$ a white ppt will form which is silver chloride

(iii) ① is $AgNO_3$; ② is Na_2S & ③ is KCl

space here

b) A 0.5246g sample of the compound was dissolved in 10.0012g of lauric acid, and it was determined that the freezing point of the lauric acid was lowered by 1.68°C. The value of K_f of lauric acid is 3.90°Cm^{-1}. Assuming that the compound does not dissociate in lauric acid.

i) Calculate the molality of the compound dissolved in the lauric acid.

ii) Calculate the molar mass of the compound from the information provided.

(i) $m = \frac{moles\ solute}{kg\ L.A.}$ • $\Delta T_{fpt} = k_f\ m$

$1.68°C = 3.90\ \frac{°C}{m}\ m$; $m = .431\ \frac{mol}{kg}$

$moles\ solute = (m)(kg\ LA) = (.431m)(.010012\ kg\ LA)$

$= .00431\ moles\ solute$ =

(ii) $MM = 121\ g/mol$

c) Without doing any calculations, explain how to determine the molecular formula of the compound based on the answers to part a(ii) and b(ii).

In a lab you would measure out 10.0012g of LA, melt it and determine its Fpt. Then you would mass out .524g of unknown & add it to the LA, melt it & determine the new Fpt. The ΔT would be 1.68°C.

- Knowing the K_f and can determine the molality by dividing the ΔT by the K_f pt constant (3.90 $\frac{°C}{m}$).
- Taking the molality multiply by the kg of solvent (.010012kg) to determine the moles of solute (unknown)
- Take the given grams of solute (.524g) and divide by the moles of solute (.00431) to determine the Molar Mass

4. Use principles of the atomic structure, bonding, and/or intermolecular forces to respond to each of the following. Your responses must include specific information about all substances referred in each question.

a) At a pressure of 1 atm, the boiling point of NH_3(l) is 240 K, whereas the boiling point of NF_3(l) is 144K.

i) Identify the intermolecular forces in each substance.
ii) Account for the difference in the boiling points of the substances.

- NH_3 possesses H-bonding as its dominant IM forces whereas the IM forces between NF_3 molecules is dipole-dipole.
- NH_3 has a higher bpt because of H bonding between NH_3 molecules so more energy is needed to overcome these strong IM forces and hence a higher bpt.

b) The melting point of KCl(s) is 776°C, whereas the melting point of NaCl(s) is 801°C.

i) Identify the type of bonding in each substance.
ii) Account for the difference in the melting points of the substances.

(i) Both KCl & NaCl are ionically bonded.

(ii) However, NaCl has a higher mpt because its Lattice energy is greater than KCl. $L.E = \frac{QQ}{d}$

Both KCl & NaCl contain +1 & -1 ions but KCl has a greater distance between these charge because K is larger the Na so more energy is needed to melt NaCl than KCl because of its slightly "stronger" Ionic Bond.