Name KEY

University of Louisville **Chem 105 Day** **Spring 2016**

Exam 2 March 7

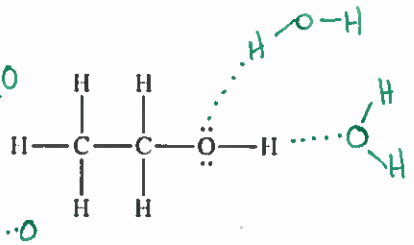
(MC score_____ FR score_____ Total raw_____ total %_____)

FREE-RESPONSE ANSWER SHEET: Write your answers in the spaces provided.

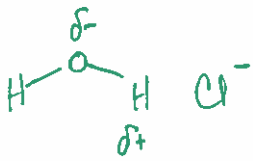
1. [4 pts] **Sketch a hydrogen bonding interaction of the molecule below with a molecule of water.**

only 1 interaction needed

(-2) for:
- problem w/ H_2O structure
- covalent — instead of ····
- H····H or O····O
- interaction w/ C or w/ H on C

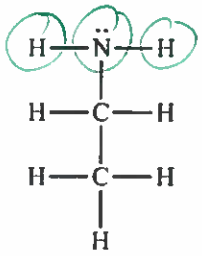


3. [3 pts]**In the space below, sketch the interaction of a **chloride ion** with a water molecule. Represent charges accurately.

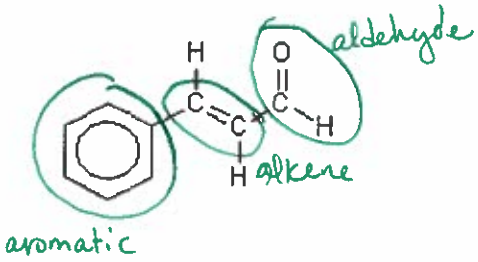


(1) Cl^- formula
(1) H_2O structure w/ δ charges
(1) interaction

2. [6 pts] In the molecule shown below, **circle all atoms that can participate in hydrogen bonding.**



4. [6 pts] The molecule shown below is a major flavor compound in cinnamon. Clearly **circle and label all functional groups** in this molecule.



5. In each space below, write and balance the equation for the reaction described. Include appropriate phase labels on all species. (Partial credit is available. At least write formulas and phase labels for all species.)

(2) each reaction
up to (2) points per formula
(2) each reaction

a. [8] **Nitric oxide reacts with elemental oxygen to produce nitrogen dioxide.**

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

reminder–phase labels?

b. [6] **Lead(II) nitrate dissociates in aqueous solution.**

$Pb(NO_3)_{2(s)} \rightarrow Pb^{2+}_{(aq)} + 2NO_3^-{}_{(aq)}$

reminder–phase labels?

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Multiple choice (problems in this section earn 1 point per correct answer.)

1 Mark A on the Scantron card. (This item is a form identifier and will not be scored.)

For items on this page, record whether each statement is A. TRUE or B. FALSE. [1 point each]

In the osmosis apparatus shown, solution X and solution Y are separated by a membrane that is ***permeable to molecular compounds and ions****. (Ethanol is CH_3CH_2OH.)*

Decide whether each of the following statements is
A. TRUE B. FALSE.

Solution X	Solution Y
0.10 M Ethanol	0.10 M NaCl
0.05 M NaCl	0.05 M Ethanol
→ 0.10 M ions	→ 0.20 M ions
= 0.20 M total solute conc	= 0.25 M total solute conc

A TRUE 2 Osmosis will occur, with water flowing from Solution X to Solution Y.

B False 3 Ethanol dialyzes from Solution ~~Y~~ X into Solution ~~X~~ Y.

B false 4 NaCl dialyzes from Solution ~~X~~ Y to Solution ~~Y~~ X.

B false 5 Over time, the volume of Solution X will ~~increase~~ decrease. (water is flowing out of X)

A TRUE 6 Both solutions will conduct electricity. NaCl is an electrolyte, so both solns conduct electricity.

NaCl dissociates, so for osmosis experiment, the total concentration of ions = 2 × [NaCl]

Record whether each statement is A. TRUE or B. FALSE.

B False 7 All ionic compounds are soluble in water.

B False 8 When balancing chemical equations, it is common that some formulas must be altered to achieve balance. We're not permitted to change formulas for balancing.

B False 9 Solids dissolve well in water, but gases do not. not all solids dissolve, and some gases do.

B False 10 When using the dilution equation $C_1 \times V_1 = C_2 \times V_2$, all volumes must be in L. volume units must match, but not necessarily L

B False 11 When more solvent is added to dilute a solution, the concentration ~~may increase~~ always decreases.

A True 12 The designation "pure substances" includes compounds and elements.

A True 13 When ionic compounds dissolve in water, they dissociate into ions.

B False 14 The concentration of a solution will differ depending on the size of the sample taken.

A True 15 Substances that dissociate to form ions in water are called electrolytes.

B False 16 The warmer the solution, the greater the solubility of a gas solute. gas solubility is greatest in cold solutions.

A True 17 A 50-ppm solution is more concentrated than a 50-ppb solution.

B False 18 "Dilution" means adding more ~~solute~~ solvent to a solution to change its concentration.

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Multiple Choice [3 points each]: Choose the **best** answer and mark the answer on the Scantron card.

19 Skip the rest of the spaces on this side of the card; turn your Scantron card over and start with #51.

51 The CO molecule has the Lewis structure shown at right. lone pair :C≡O: lone pair
(C has a nonstandard bonding arrangement in this molecule–use the structure given.) How many **lone pairs** are in the CO molecule?

A 1 B 2 C 4 D 6 E 12

52 How many **bonding electrons** are in the CO molecule? 3 bonds = 6 e⁻

A 2 B 3 C 4 D 6 E 10

53 In which of the following bonds would nitrogen have a partial positive (δ+) charge? O is more electronegative than N, so

A NaN B CN C NN D NO

E none of these; nitrogen is never positive

N—O
δ+ δ−

54 Which bond is **nonpolar**? same electronegativity

A NaN B CN C NN D NO E more than one, or none

55 Which of the following represents a **physical** change, rather than a chemical reaction? → no change in formulas

A $2H_2O\ (l) \rightarrow H_3O^+\ (aq) + OH^-\ (aq)$
B $H_2O\ (l) \rightarrow 2\ H\ (g) + O\ (g)$
C $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$
D $2\ H_2O\ (l) \rightarrow 2\ H_2\ (g) + O_2\ (g)$
E $H_2O\ (g) \rightarrow H_2O\ (l)$

56 You need to make 200 mL (V_2) of 0.86% (C_2) (w/v) sodium lactate in water. You have a bottle of 5% (C_1) (w/v) sodium lactate solution, which you must dilute to the correct concentration. What volume of the 5% solution should you use?

$C_1V_1 = C_2V_2$

$V_1 = \frac{C_2V_2}{C_1} = \frac{(200\text{mL})(0.86\%)}{5\%} = 34.4\text{mL}$

A 0.029 mL B 34.4 mL C 100 mL D 291 mL E 860 mL

57 One of the following ionic compounds is **insoluble** in water. Which one is it? → no $Na^+, K^+, NH_4^+, NO_3^-, Cl^-$

A potassium hydroxide B iron(III) nitrate C sodium sulfide
D calcium chloride E aluminum carbonate

58 Which solution is isotonic with blood plasma (total solute concentration = 0.28 M)?

nonelectrolyte → A 0.14 M ethanol, CH_3CH_2OH B 0.14 M sodium iodide NaI → total ion conc = 0.28M
C 0.14 M magnesium chloride $MgCl_2$ D more than one of these
E none of these → total ion conc = 0.42 M

59 Which of the solutions in the previous problem would cause a cell to undergo hemolysis (burst)?

A 0.14 M ethanol, CH_3CH_2OH B 0.14 M sodium iodide
C 0.14 M magnesium chloride D more than one of these
E none of these

60 Which of the following is a reasonable mass for a single atom?

A 0.5 amu B 5 amu C 0.5 grams D 5 grams E more than one of these

would be half of a single p⁺ or n° — can be one atom — many, many atoms

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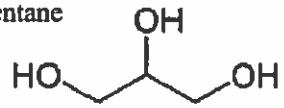
The next several questions refer to these five options. In this and the following sets, you may use an answer once, more than once, or not at all. Hint: draw the structures of 2-methylpentane and propene.

A glycerol (see structure) B 3-pentanol (see structure) C 2-methylpentane

D propene E More than one of these, or none of these



A glycerol

A 61 Which substance has the strongest total attractions between its molecules?

A, B & C are similar sizes and have similar dispersion forces.

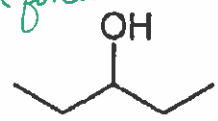
E 62 Which substance is ionic? (none)

D is the smallest molecule, no H-bonding

D 63 Which compound is expected to have the **lowest** boiling point?

A has the most Hydrogen bonding.

A 64 Which compound is expected to have the greatest solubility in water? most hydrophilic, least hydrophobic

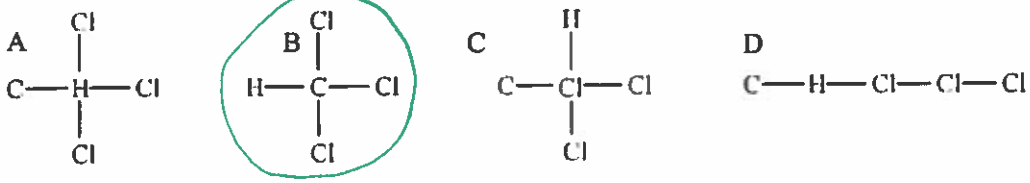


B 3-pentanol

D 65 Which compound is a gas at room temperature? 1-4 C atoms, hydrocarbon

C 2-methylpentane

66 Which of the following is a reasonable structure for the compound $CHCl_3$, based on the normal bonding requirements of the atoms involved?



E. more than one of these is reasonable.

~25°C

67 Carbon tetrachloride is a **liquid** at room temperature. It was once commonly used in dry cleaning fabrics. Which of the following sets of values could apply to carbon tetrachloride?

	melting point	boiling point
A	–23 °C	77 °C
B	37 °C	150°C
C	77 °C	0 °C
D	–20 °C	0 °C
E	35 °C	150°C

If it's (ℓ) at 25°C, then the mp is below 25°C and the bp is above 25°C

ionic compound

68 Calcium chloride is a white, crystalline substance that melts at 772 °C. Which statement correctly describes its high melting point?

A Melting the substance requires breaking ~~covalent~~ bonds between the calcium and chloride atoms.

B Melting the substance requires breaking ionic bonds to separate the calcium ions and chloride ions.

C Melting the substance requires getting ~~water molecules~~ between the atoms or ions.

D Melting the substance requires overcoming hydrogen bonds between the calcium chloride molecules.

E Melting the substance requires overcoming dispersion forces between the calcium chloride molecules.

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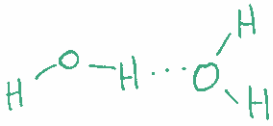
69 What types of attractive forces (if any) exist between the **oxygen and hydrogen atoms in a single water molecule?**

A ionic bonds B covalent bonds C dispersion forces
D hydrogen bonds E both dispersion forces and hydrogen bonds

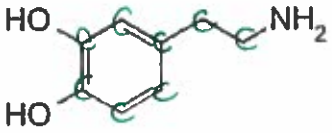
70 What types of attractive forces (if any) exist between **two separate water molecules?**

A ionic bonds B covalent bonds C dispersion forces
D hydrogen bonds E both dispersion forces and hydrogen bonds



71 The structure of dopamine, an important neurotransmitter, is shown. How many **carbon atoms** are there in the dopamine molecule?

A 6 B 7 C 8 D 9 E more than 9



dopamine

72 Which statement is **true** for dopamine?

A Dopamine contains a carboxylic acid functional group.
B Dopamine is a hydrocarbon.
C Dopamine is an ionic compound.
D Dopamine is an organic compound.
E More than one of these statements is true.

73 Which set of characteristics is TRUE for dopamine?

	Hydrogen bonding as pure substance?	Hydrogen bonding with water molecules?
A	no	no
B	yes	no
C	no	yes
D	yes	yes

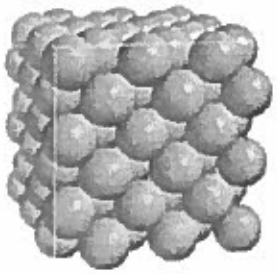
74 The concentration of LDL in Fred's blood plasma is 173 mg/dL. What is the total mass, in **grams**, of LDL in 600 mL of his blood plasma?

A 0.288 g B 0.1625 g C 1.04 g D 28.3 g E 104 g

$\frac{173\text{ mg}}{\text{dL}} \times \frac{1\text{ dL}}{100\text{ mL}} \times \frac{1\text{ g}}{1000\text{ mg}} \times 600\text{ mL} = 1.04\text{ g}$

75 Which category is correct for the substance represented in the picture at right?

all atoms are the same



A element B ionic compound C molecular/covalent compound
D heterogeneous mixture E homogeneous mixture

76 Which phase label is correct for the substance represented?

A (s) B (l) C (g) D (aq)

atoms are stacked in a highly ordered structure

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