

Chemistry 1C
Exam #1
April 22, 2009
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Form A
Yellow Exam

9 Pages, 37 Questions

DO NOT TURN THE PAGE UNTIL TOLD TO BEGIN

You will have 50 minutes for this exam. No notes are allowed. No sharing of calculators, no hats/hoods, no phones / iPods / etc.

BEFORE YOU BEGIN

On your Scantron answer sheet:

- Fill in the “test form”. This yellow exam is **Form A**.
 - Fill in your perm number. Seven digits only.
 - Write your name on the Scantron answer sheet.

Completely fill bubbles ●

Completely fill answers ■

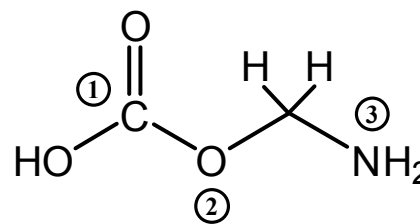
This is a multiple choice exam. You will only receive credit for answers you mark on the separate, scantron answer sheet.

Each question is worth 2 points unless noted otherwise.

The last page of the exam is an info sheet that you can **carefully** tear off if you wish.

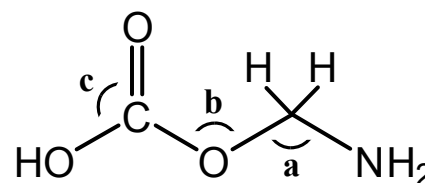
You can use this booklet for your work. Turn in the scantron answer sheet when you are done, and take this booklet with you to check your answers online.

All questions on this page are about the following molecule:
Note that not all bonds, atoms and lone pairs are shown.



- How many π bonds are present in this molecule?
 - 1
 - 2
 - 7
 - 10
 - 11
- How many σ bonds are present in this molecule?
 - 1
 - 2
 - 7
 - 10
 - 11
- What is the hybridization of the labeled carbon atom (1)? (3pts)
 - none
 - sp
 - sp^2
 - sp^3
 - dsp^3
- What is the hybridization of the labeled oxygen atom (2)? (3pts)
 - none
 - sp
 - sp^2
 - sp^3
 - dsp^3
- What is the hybridization of the labeled nitrogen atom (3)? (3pts)
 - none
 - sp
 - sp^2
 - sp^3
 - dsp^3

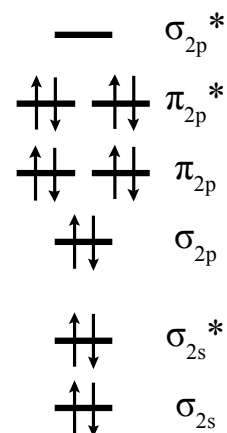
The molecule has been redrawn with certain bond angles labeled:



- Describe the angle of bond a.
 - 90°
 - 104.5°
 - 109.5°
 - 120°
 - 180°
- Describe the angle of bond b.
 - 90°
 - 104.5°
 - 109.5°
 - 120°
 - 180°
- Describe the angle of bond c.
 - 90°
 - 104.5°
 - 109.5°
 - 120°
 - 180°

- 9) What is the hybridization of the phosphorous atom in PCl_4^+ ? (4pts)
- a) sp b) sp^2 c) sp^3 d) dsp^3 e) d^2sp^3
- 10) What is the electron configuration of the molecular orbitals in the N_2^+ molecule? (5pts)
- a) $(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2p})^2 (\pi_{2p})^3$
- b) $(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\sigma_{2p})^2 (\pi_{2p})^4$
- c) $(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\pi_{2p})^4 (\sigma_{2p})^1$
- d) $(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\pi_{2p})^4$
- e) $(\sigma_{2s})^2 (\sigma_{2s}^*)^2 (\pi_{2p})^4 (\sigma_{2p})^2$

Use the Molecular Orbital diagram of the OF^- molecule at right for problems 11-15.



- 11) What is the bond order of OF^- ?
- a) 0 b) 1 c) 1.5 d) 2
- 12) Is OF^- paramagnetic?
- a) yes b) no
- 13) Suppose you remove one electron to make the neutral molecule OF. What is the bond order of OF?
- a) 0 b) 1 c) 1.5 d) 2 e) 2.5
- 14) Is the neutral molecule OF paramagnetic?
- a) yes b) no
- 15) Which molecule has the stronger bond?
- a) OF^- b) OF c) The bonds are the same strength

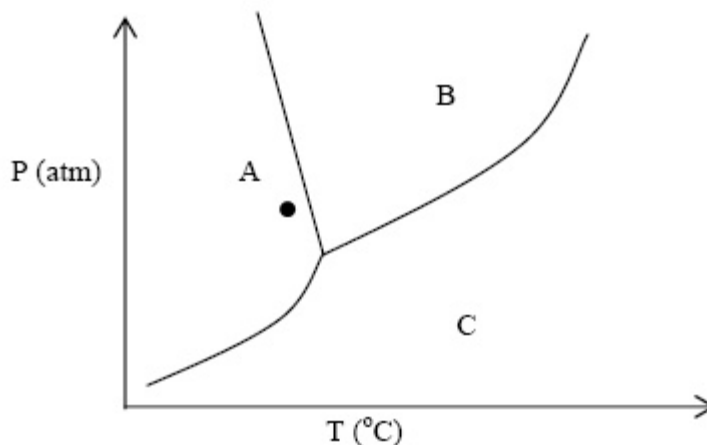
- 16) What is the dominant intermolecular force for diatomic bromine, Br₂? (3pts)
- a) Hydrogen bonding
 - b) Dipole-dipole forces
 - c) Dispersion forces**
 - d) No intermolecular forces are present
- 17) What is the dominant intermolecular force for ethanol, CH₃CH₂OH? (3pts)
- a) Hydrogen bonding**
 - b) Dipole-dipole forces
 - c) Dispersion forces
 - d) No intermolecular forces are present
- 18) What is the dominant intermolecular force for carbon tetrachloride, CCl₄? (3pts)
- a) Hydrogen bonding
 - b) Dipole-dipole forces
 - c) Dispersion forces**
 - d) No intermolecular forces are present
- 19) Select the molecule with the highest boiling point (3pts)
- a) F₂
 - b) HF**
 - c) HBr
- 20) Select the molecule with the lowest vapor pressure at a given temperature (3pts)
- a) HOCH₂CH₂CH₂OH**
 - b) CH₃CH₂CH₂CH₂CH₃
 - c) CH₃CH₂CH₂CH₂OH
- 21) Select the molecule with the highest viscosity (3pts)
- a) HOCH₂CH₂CH₂OH**
 - b) CH₃CH₂CH₂CH₂CH₃
 - c) CH₃CH₂CH₂CH₂OH

- 22) What type of crystalline solid does NH_4Cl form?
a) ionic b) molecular c) atomic
- 23) What type of crystalline solid does urea, H_2NCONH_2 , form?
a) ionic b) molecular c) atomic
- 24) What type of crystalline solid does Cl_2 form?
a) ionic b) molecular c) atomic

Consider the phase diagram for water at right.

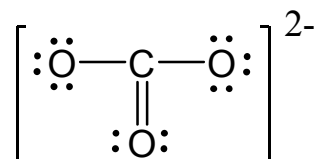
- 25) What phase is represented by the region labeled "B"?

- a) liquid
b) solid
c) gas
d) plasma



- 26) Starting at the black dot in region "A", what phase change occurs if the pressure is increased at constant temperature? (3pts)
- a) solid → liquid
b) liquid → gas
c) gas → liquid
d) liquid → solid
e) solid → gas

The Lewis structure for the carbonate ion, CO_3^{2-} , is shown to the right. Use this Lewis structure to answer questions 27-30.



- 27) What is the molecular geometry of the carbonate ion?
- tetrahedral
 - trigonal planar**
 - trigonal pyramidal
 - T-shaped
 - see-saw
- 28) How many total resonance structures should the Lewis structure for the carbonate ion have?

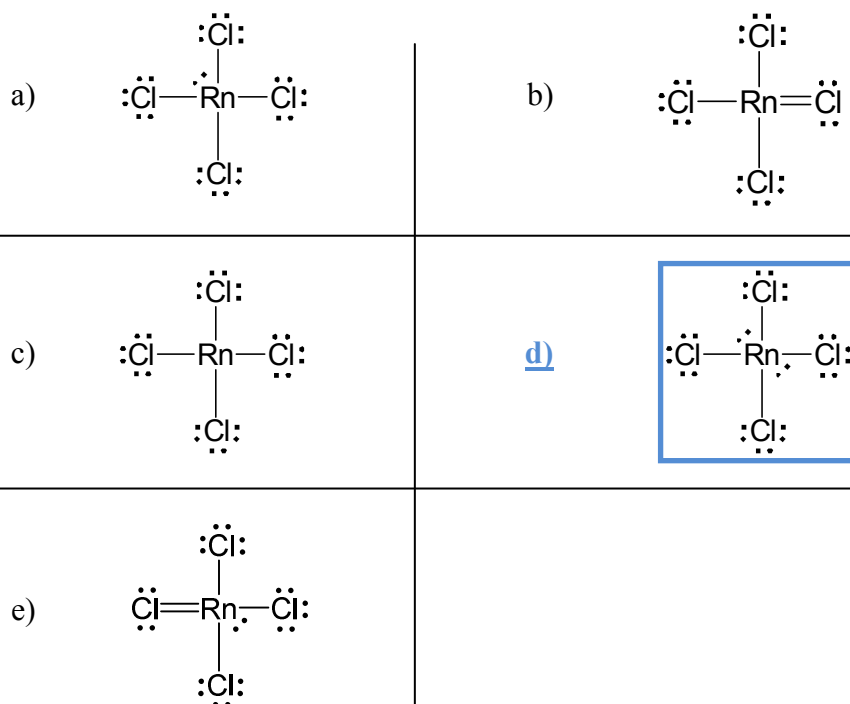
	<u>Number</u>	<u>Schematic Depiction</u>
a)	1	[]
b)	2	[] \longleftrightarrow []
c)	<u>3</u>	<u>[] \longleftrightarrow [] \longleftrightarrow []</u>
d)	4	[] \longleftrightarrow [] \longleftrightarrow [] \longleftrightarrow []

- 29) What is the formal charge of the carbon in the carbonate ion?
- 2
 - 1
 - 0**
 - + 1
 - +2
- 30) What is the formal charge of the oxygen connected by a single bond in the carbonate ion?
- 2
 - 1**
 - 0
 - + 1
 - +2
- 31) What is the molecular geometry of nitrogen trifluoride, NF_3 ? (4pts)
- tetrahedral
 - trigonal planar
 - trigonal pyramidal**
 - bent
- 32) Is nitrogen trifluoride, NF_3 , a polar molecule?
- yes**
 - no

33) How many lone pairs are on the nitrogen atom in the Lewis structure of the nitrite ion (NO_2^-)? (3pts)

- a) 0 b) 1 c) 2 d) 3 e) 4

34) What is the correct Lewis structure for radon tetrachloride, RnCl_4 ? Radon is element number 86. (4 pts)



35) What is the molecular geometry of radon tetrachloride, RnCl_4 , as given by VSEPR theory?

- a) tetrahedral
b) square planar
 c) see-saw
 d) T-shaped
 e) octahedral

36) Is radon tetrachloride, RnCl_4 , a polar molecule?

- a) yes b) no

- 37) Acetic acid has a boiling point of 118°C in Santa Barbara (at 760 torr) and a boiling point of 106°C in Denver (at 520 torr). What is ΔH_{vap} for acetic acid? (8pts)
- a) 39000 kJ/mol (partial credit of 3 points)
- b) 3.29 kJ/mol
- c) 385 kJ/mol
- d) 39.0 kJ/mol**
- e) 3.69 J/mol

Use This Equation:
$$\ln \left(\frac{P_{\text{vap}}^{T_1}}{P_{\text{vap}}^{T_2}} \right) = \frac{\Delta H_{\text{vap}}}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

Givens: $P_{\text{vap}}, T_1 = 760 \text{ torr}$ $P_{\text{vap}}, T_2 = 520 \text{ torr}$
 $T_1 = 118^\circ\text{C}$ $T_2 = 106^\circ\text{C}$
 $R = 8.3145 \text{ J mol}^{-1} \text{ K}^{-1}$

Find: ΔH_{vap}

Convert C to K $T_1 = 118^\circ\text{C} + 273.2 = 391.2$ $T_2 = 106^\circ\text{C} + 273.2 = 379.2$

Plug in numbers:
$$\ln \left(\frac{760 \text{ torr}}{520 \text{ torr}} \right) = \frac{\Delta H_{\text{vap}}}{8.31451 \text{ J mol}^{-1} \text{ K}^{-1}} \left(\frac{1}{379.2 \text{ K}} - \frac{1}{391.2 \text{ K}} \right)$$

$$0.37949 = \frac{\Delta H_{\text{vap}}}{8.31451 \text{ J mol}^{-1} \text{ K}^{-1}} (8.089 \times 10^{-5} \text{ K}^{-1})$$

$$\Delta H_{\text{vap}} = 39000 \text{ J/mol} = 39.0 \text{ kJ/mol}$$

Choosing answer b) gave you partial credit of 3 points