

Exam 3A

Chem 960
Fall 2009
Maleckar
100 points



Initial of last name

NAME KEY

Multiple Choice _____ (45)

Circle / FGs _____ (24)

Naming & #13 _____ (21)

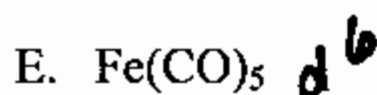
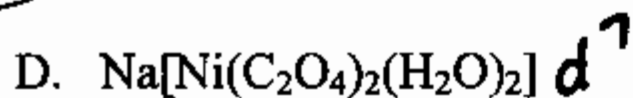
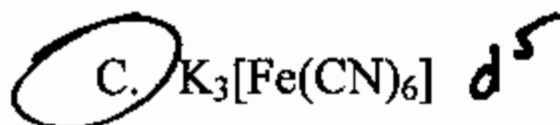
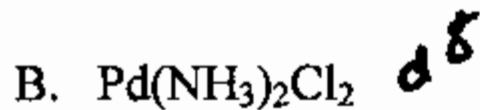
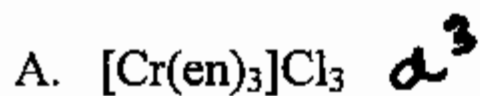
Problem #14 _____ (10)

TOTAL _____ **(100)**

Multiple Choice Circle the letter of the correct answer.

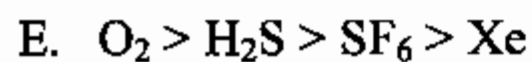
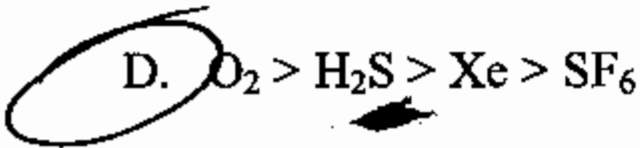
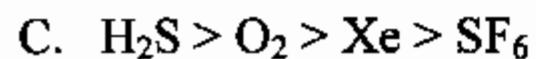
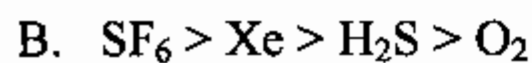
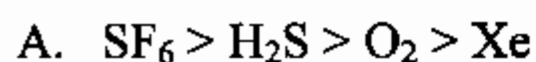
5 pts. each A

1. Which of the following complexes contains a metal that is d^5 ?

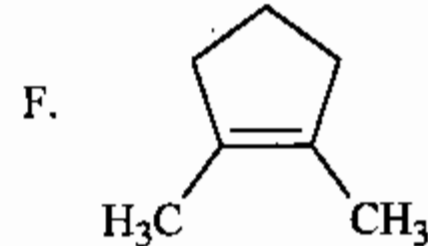
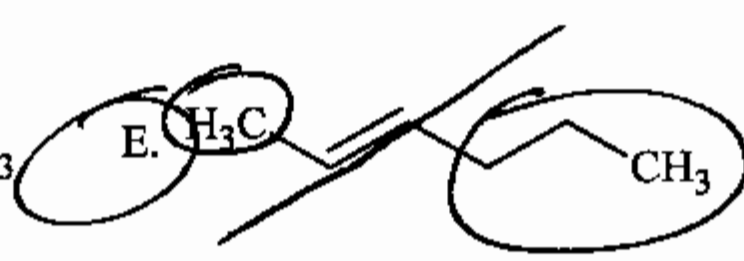
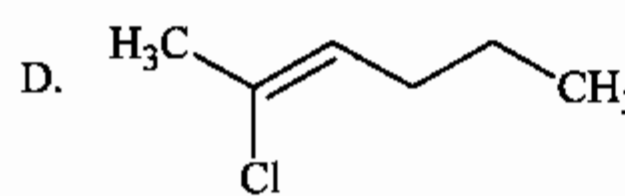
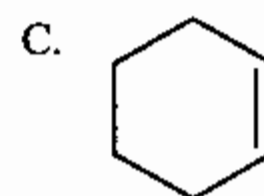
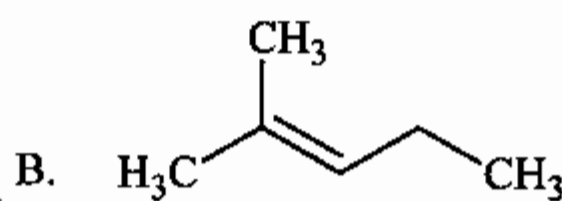
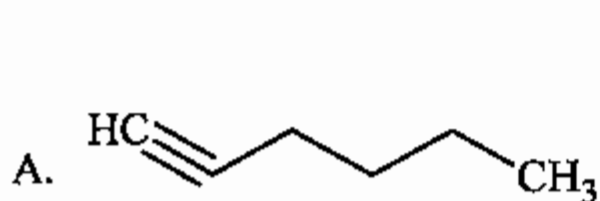


2. Which of the following rankings of average molecular speed is correct for the following gases at the same temperature?

MW
 Xe 131
 SF₆ 146
 O₂ 32
 H₂S 34



3. Which of the following compounds is trans as drawn below?



4. In $[\text{Fe}(\text{en})_2(\text{NO}_2)_2]^+$, the coordination number is _____ and the oxidation number of the Fe is _____.

- A. 4, +5
- B. 4, +3
- C. 4, +1
- D. 6, +5
- E. 6, +3**
- F. 6, +1

5. How many seconds would it take one molecule of Cl_2 to diffuse 120yd, the length of a football field including end zones, on a 25°C (77°F) day, assuming that it travels along a linear path?

- A. 0.339 sec**
- B. 3.41 sec
- C. 10.23 sec
- D. 10.72 sec
- E. 32.14 sec

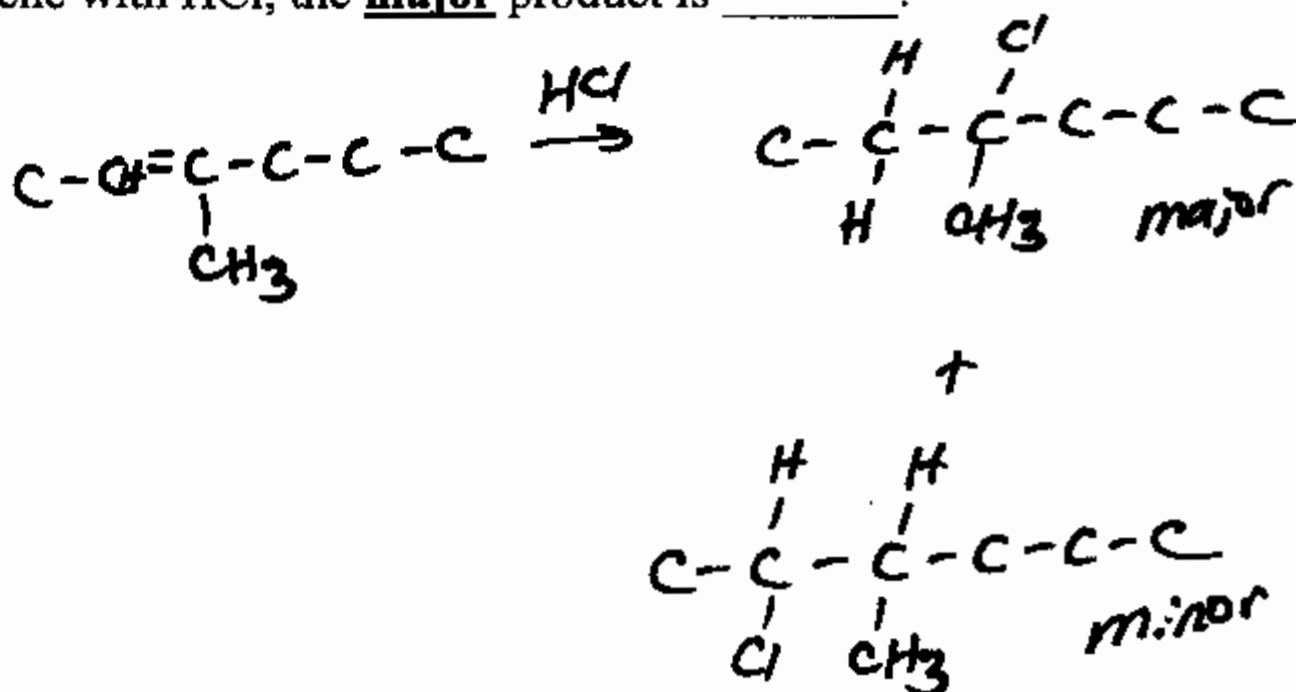
$$u = \sqrt{\frac{3(8.314)(298)}{0.071}} \quad \text{71 g/mole}$$

$$u = 323.6 \text{ m/s}$$

$$(120 \text{ yd}) \left(\frac{\text{m}}{1.094 \text{ yd}} \right) \left(\frac{\text{sec}}{323.6 \text{ m}} \right) = 0.339 \text{ sec}$$

6. When you react 3-methyl-2-hexene with HCl, the major product is _____

- A. 4-chloro-4-methylhexane
- B. 3-chloro-3-methylhexane**
- C. 2-chloro-3-methylhexane
- D. 5-chloro-4-methylhexane
- E. there is no reaction



7. Nickel forms a gaseous compound of the formula $Ni(CO)_x$. What is the value of x given the fact that under the same conditions of temperature and pressure, methane (CH_4) effuses 3.3 times faster than the compound?

- A. 0
- B. 1
- C. 2
- D. 3
- E. 4**
- F. none of these

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

$$\frac{3.3}{1} = \sqrt{\frac{M}{16}}$$

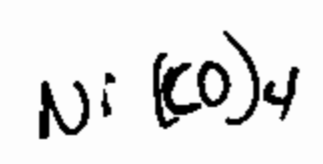
$$10.89 = \frac{M}{16}$$

$$M = 174.24 \text{ g/mole}$$

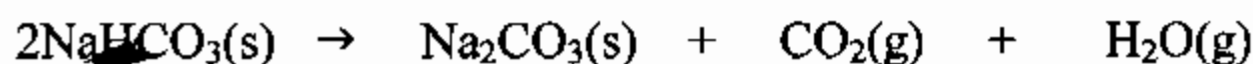
$$\begin{array}{r} 174.24 \\ - 58.6 \quad (Ni) \\ \hline 115.64 \end{array}$$

CO: MW = 28

$$\frac{115.6}{28} = 4$$



8. Sodium hydrogen carbonate, $NaHCO_3$, is also known as baking soda. When this compound is heated, it decomposes to sodium carbonate, carbon dioxide, and water vapor. You add 1 teaspoon (5.7g) of baking soda to your cake batter. What volume (in liters) of carbon dioxide will be produced at $350^\circ F$ ($177^\circ C$) and 740 mm Hg?



- A. 1.29L**
- B. 5.14L
- C. 2.57L
- D. 1.01L
- E. 0.506L

$$(5.7g) \left(\frac{\text{mole}}{84g} \right) \left(\frac{1}{2} \right) = 0.0339 \text{ moles } CO_2$$

$$\frac{740}{760} = 0.9737 \text{ atm}$$

$$V = \frac{(0.0339)(.08206)(450)}{.9737} = 1.29L$$

9. A piece of sodium metal undergoes complete reaction with water as follows:



The hydrogen gas, collected over water at 25°C, is 246 ml, measured at 745 mm Hg. How many grams of Na were used in the reaction? $P_{\text{H}_2\text{O}} @ 25^\circ\text{C} = 23.78 \text{ mm Hg}$

$$745 - 23.78 = \frac{721.22 \text{ mm}}{760} = 0.9489 \text{ atm}$$

$$n = \frac{(0.9489)(.246)}{(0.08206)(298)} = .009546 \text{ moles H}_2$$

A. 0.220g

B. 0.439g

C. 0.227g

D. 0.454g

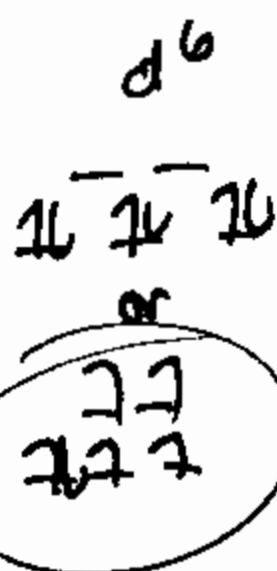
$$(.009546 \text{ moles H}_2) \left(\frac{2 \text{ Na}}{1 \text{ H}_2} \right) = .01909 \text{ moles Na}$$

$$(.01909 \text{ moles}) \left(\frac{23 \text{ g}}{\text{mole}} \right) = 0.439 \text{ g}$$

Circle It!

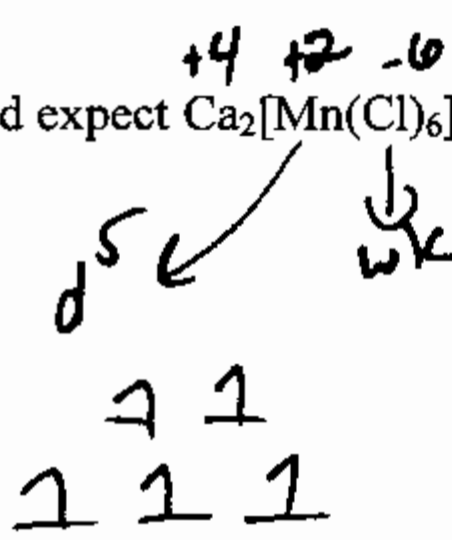
Circle the correct answer in every underlined set of words to complete the sentences.

10a. If you were told that $[\text{Rh}(\text{H}_2\text{O})_6]\text{Br}_3$ is paramagnetic, you could conclude that it has ligands that ~~bind~~ bind strongly / weakly. It will be labeled as high-spin / low-spin. This corresponds to a small / large Δ value, and this complex absorbs light of a short / long wavelength.



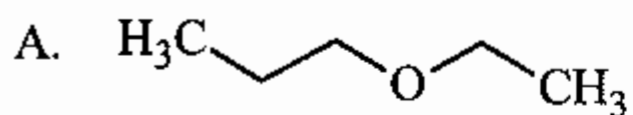
10b. If you react an alkene with excess hydrogen and a catalyst, the product will be an alkane / alkene / alkyne.

10c. You would expect $\text{Ca}_2[\text{Mn}(\text{Cl})_6]$ to have 5 / 1 unpaired electrons in its d orbitals.

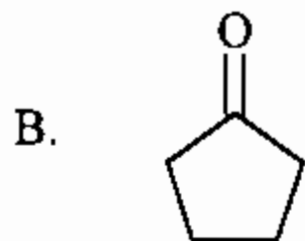


2 pts for each circled item
12 pts total

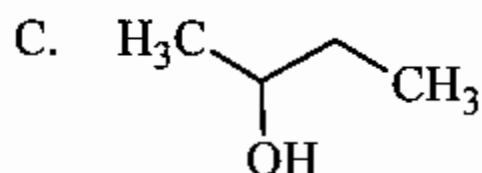
Functional Groups Write the name of the functional group on the line beside the structure. Your choices are: alcohol, aldehyde, amide, amine, carboxylic acid, ether, ester, and ketone.



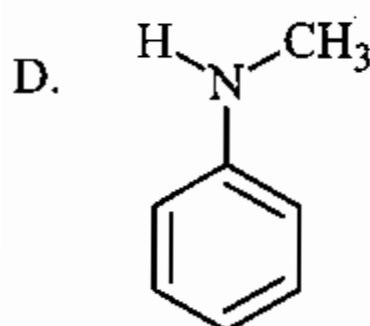
ether



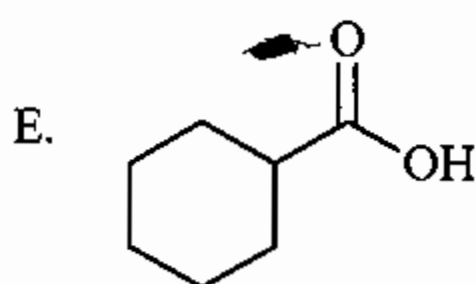
ketone



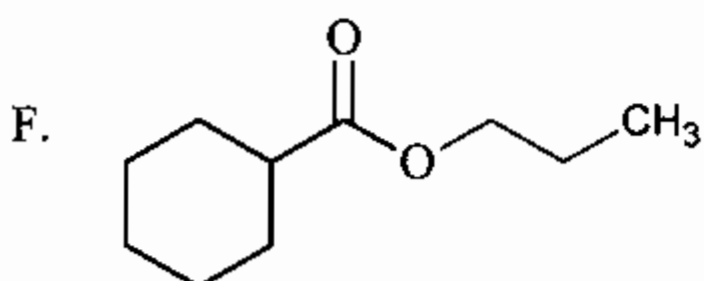
alcohol



amine



carboxylic acid

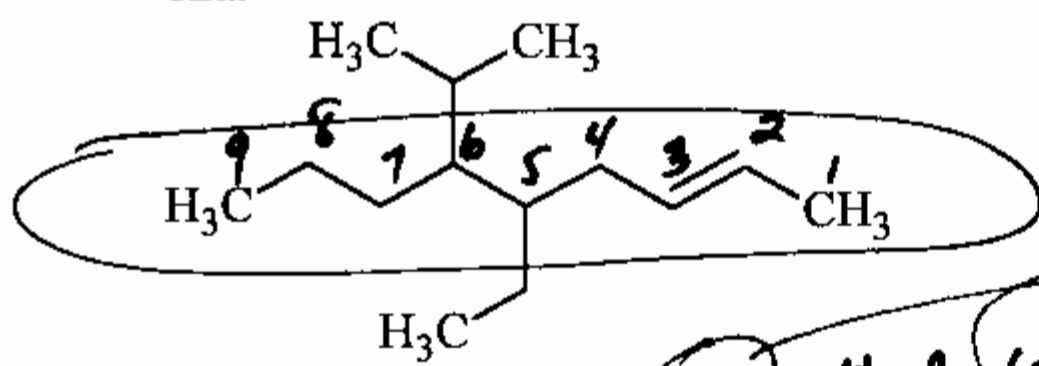


ester

2 Pts. each
12 total

Naming Name the following compounds. Use cis/trans where warranted.

12a.



trans-5-ethyl-6-isopropyl-2-nonene
1 pt.

15 pts. total

12b. $\text{Li}[\text{Cr}(\text{H}_2\text{O})_2(\text{CN})_6]$
+1 +5 0 -6

lithium diaqua hexacyanochromate (II)

12c. $[\text{Pt}(\text{NO})_2\text{Cl}_2]\text{Br}_3$
+7 -2 -2 -3

dichloro dinitro platinum (VII) bromide

Miscellaneous Problems

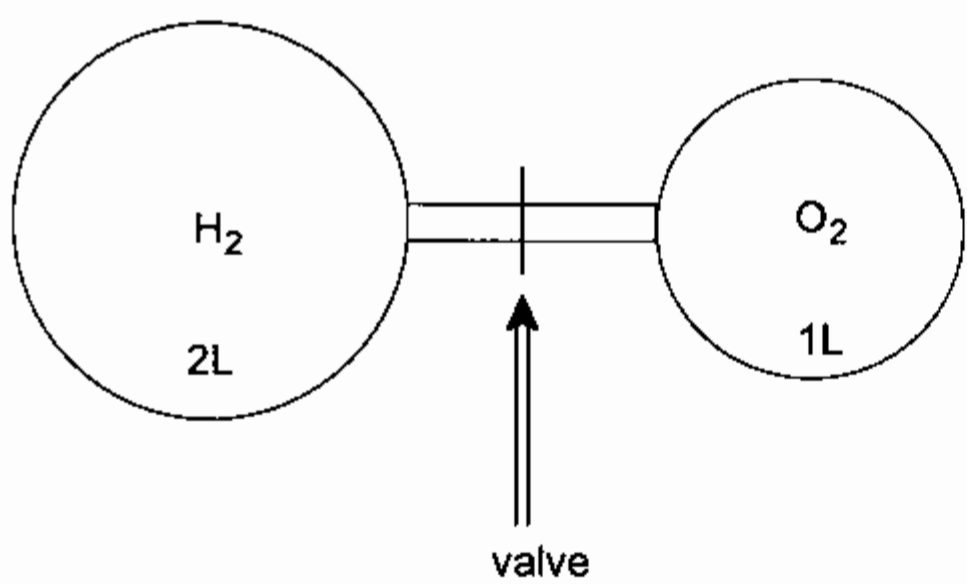
13. Three complexes of cobalt, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{CN})_6]^{3-}$, and $[\text{CoF}_6]^{3-}$, absorb light of 440nm, 565nm, and 770nm. Match the correct complex to the correct wavelength, then give the expected color that each complex would appear to be.

<u>Complex</u>	<u>Absorbed Wavelength</u>	<u>Observed Color</u>
$[\text{Co}(\text{NH}_3)_6]^{3+}$ med.	565nm	violet
$[\text{Co}(\text{CN})_6]^{3-}$ str.	440nm	orange
$[\text{CoF}_6]^{3-}$ wk.	770nm	green/yellow

1 pt. each,
6 pts. total

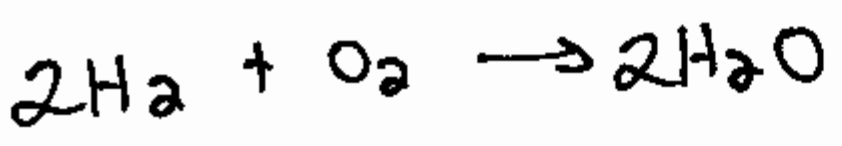
weak ligands = small Δ = large λ absorbed

14. You have the apparatus below, with one side containing H₂ at 0.5 atm and the other side containing O₂ at 0.75 atm. You open the valve, allowing the two gases to mix and react, forming only H₂O (g). The temperature is fixed at 533K.



10pts.

After the reaction has gone to 100% completion, what is the overall pressure in the vessel? What are the partial pressures of H₂, O₂, and H₂O? Assume the volume of the tube connecting the two spherical chambers is negligible.



n = PV/RT = (0.5)(2L) / (.08206)(533) = 0.02286 moles H₂

(0.02286 moles H₂) * (102 / (2H₂)) = .01143 moles O₂ needed
∴ H₂ is L.R.

n = (0.75)(1L) / (.08206)(533) = 0.01715 moles O₂

H₂ is the L.R., so have none left after the rxn. P_{H₂} = 0 2

.01715 moles O₂
- .01143

.00572 moles O₂ left after the rxn.

P_{O₂} = nRT/V = (.00572)(.08206)(533) / 3L = 0.0834 atm 2

after the rxn, you have .02286 moles H₂O

P_{H₂O} = (.02286)(.08206)(533) / 3L = 0.333 atm 2

P_{total} = 0 + .0834 + .333 = 0.417 atm 1

3pts - work

Equations and Constants

$$PV = nRT$$

$$u = (3RT/M)^{1/2}$$

$$\frac{r_1}{r_2} = (M_2/M_1)^{1/2}$$

$$\begin{aligned} R &= 0.08206 \text{ atm-L/mole-K} \\ &= 8.314 \text{ J/mole-K} \\ &= 8.314 \text{ kg-m}^2/\text{s}^2\text{-mole-K} \end{aligned}$$

$$1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr}$$

$$K = ^\circ\text{C} + 273$$

$$100 \text{ cm} = 1 \text{ m}$$

$$1000 \text{ ml} = 1 \text{ L}$$

$$1 \text{ cm}^3 = 1 \text{ ml}$$

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

