KWANTLEN UNIVERSITY COLLEGE
CHEMISTRY 1110 R11 Spring 2004
Dr. Jennifer Wolf
EXAM No. 1
Wednesday, February 18, 2004

Name: _____

Student Number_____

Instructions: Ensure that this exam contains all **eleven** questions. Read the exam carefully and judge your time accordingly. ***All work must be shown to receive any credit.*** If you need extra space, use the back of a preceding page and clearly indicate the question number. Rough work may also be done on the back of a preceding page. A periodic chart is supplied with this exam.
Maximum Score: 70 marks

POTENTIALLY USEFUL INFORMATION:

Avogadro's Number: 6.0221×10^{23}

$PV = nRT$

Gas Constant: $R = 0.08206$ Latm mol^{-1} K^{-1}

1 atm = 760 mm Hg = 760 torr (exactly)

$T(K) = T(^{o}C) + 273.15$

$r_2/r_1 = t_1/t_2 = (MM_1/MM_2)^{1/2}$

$P_{total} = P_1 + P_2 + P_3 \ldots$

$P_i = \chi_i P_{total}$

$c = \lambda\nu$ $\quad E = h\nu$

$h = 6.6.26 \times 10^{-34}$ J s

$c = 2.998 \times 10^{8}$ m s^{-1}

Question	Marks
1	/5
2	/6
3	/6
4	/6
5	/4
6	/4
7	/6
8	/5
9	/6
10	/14
11	/8
TOTAL	/70

Question 1 (5 marks)

A compound containing only Cl and O reacts with hydrogen gas to give 0.233 g HCl and 0.403 g H_2O.

(a) Determine the empirical formula of the compound.

(b) In a separate experiment, HCl gas was found to effuse 2.24 times faster than a gas sample of the chlorine-oxygen compound. What is the molecular formula of the compound?

Question 2 (6 marks)

A 0.9157 g mixture of $CaBr_2$ and NaBr is dissolved in water and excess $AgNO_3$ is added to the solution to form AgBr precipitate. If the mass of the precipitate is 1.693 g, what is the percent by mass of NaBr in the original mixture?

[Molar masses: NaBr = 102.89 g/mol; $CaBr_2$ = 199.88 g/mol; AgBr = 187.8 g/mol]

$$CaBr_2 + 2\ AgNO_3 \rightarrow Ca(NO_3)_2 + 2\ AgBr\ (s)$$

$$NaBr + AgNO_3 \rightarrow NaNO_3 + AgBr\ (s)$$

Question 3 (6 marks)

A 1.00-g sample of a metal **M** (that is known to form $\mathbf{M}^{2+}$ ions) was added to 0.100 L of 0.500 M H_2SO_4 (excess acid). The remaining acid was titrated with 33.4 mL of 0.500 M NaOH. Determine **M**.

Reactions:

$\mathbf{M} + H_2SO_4 \rightarrow \mathbf{M}SO_4 + H_2$

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

Question 4 (6 marks)

Nitric oxide (NO) reacts with molecular oxygen as follows:

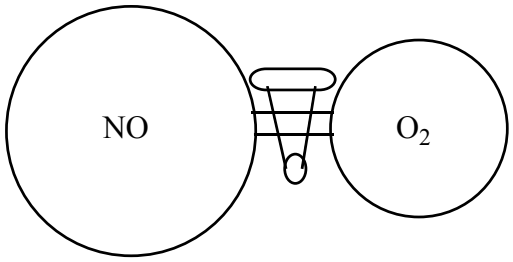
$$2\ NO\ (g) + O_2\ (g) \rightarrow 2\ NO_2\ (g)$$

Initially, NO and O_2 are separated as shown below. When the valve is opened and the gases are allowed to mix, the reaction quickly goes to completion. The temperature remains constant at 25 ºC.

Determine:

(a) which gases are present at the end of the reaction
(b) the partial pressures of each gas after the reaction
(c) the total pressure in the system after the reaction

[Note: you can neglect the volume of the connecting tube.]



4.00 L
0.500 atm

2.00 L
752 torr

Question 5 (4 marks)

A ruby laser produces radiation of wavelength 633 nm in pulses whose durations are 1.00×10^{-9} s.

(a) What is the energy of of the radiation produced by the laser (the energy of one "photon")?

(b) If the laser produces 0.376 J of energy per pulse, how many photons are produced per pulse?

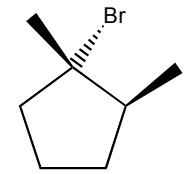
Question 6 (4 marks)

The energy levels in any one-electron species are given by the expression:

$$E_n = -2.179 \times 10^{-18}\ J\ \ Z^2/n^2$$

Calculate the frequency of the radiation emitted when an electron in a Li^{2+} ion falls from n = 4 to the ground state.

Question 7 (6 marks)



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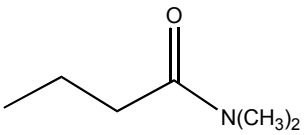

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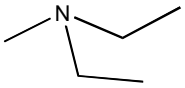

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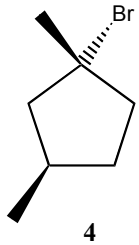

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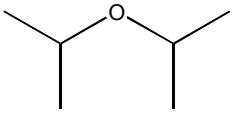

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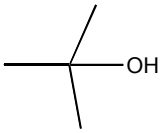

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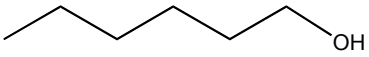

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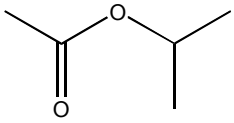
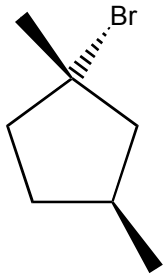
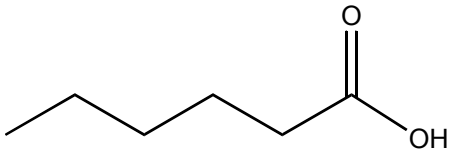


8

Indicate which of compounds 1-8 above would be examples of the following:
(NOTE: A compound may be used more than once.)

a) amide Answer: ___	b) ether Answer: ___
c) an optical isomer of  Answer: ___	d) a functional isomer of  Answer: ___
e) a compound that will react with $KMnO_4$ Answer: ___	f) a tertiary amine Answer: ___

Question 8 (5 marks)

Draw structures (showing **all hydrogens**) of each of the following molecules, and indicate which will show cis/trans isomerism (geometric isomerism):

a) 1,4-dibromocycloheptane

b) para-iodobenzaldehyde

c) 4-cyclopropyl-2-pentyne

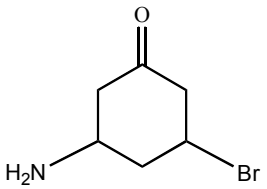
d) ethyl 5-bromo-4-isopropylheptanoate

e) 3-ethyl-5-phenyl-1,3-octadiene

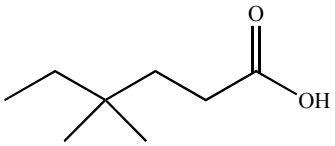
Question 9 (6 marks)

Give systematic names for each of the following:

a)



b)



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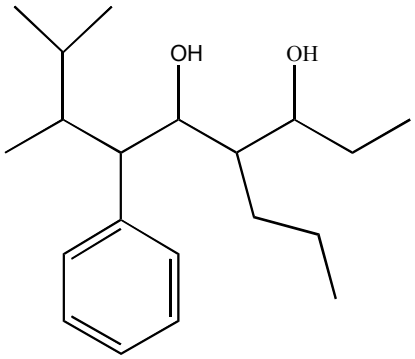
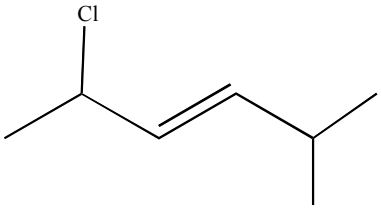
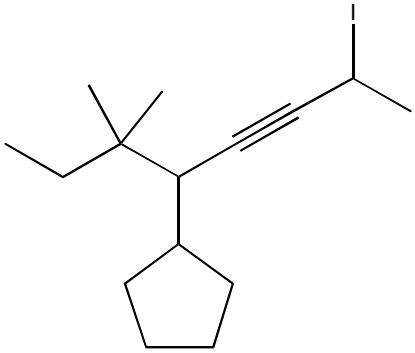


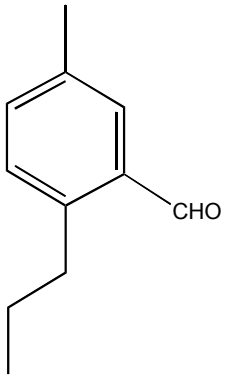
d)



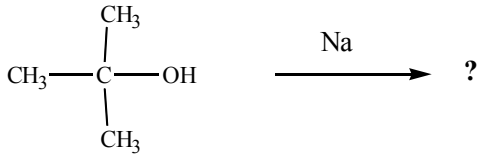
e)

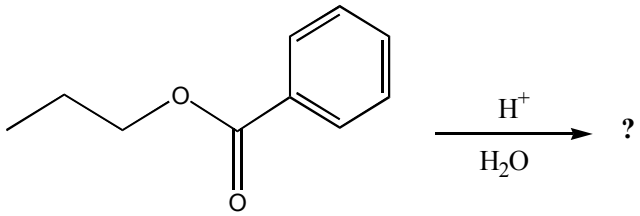


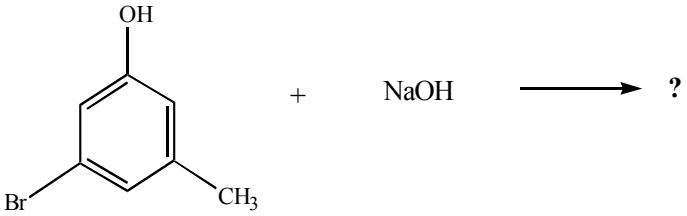
f)

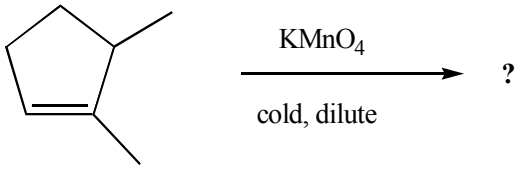


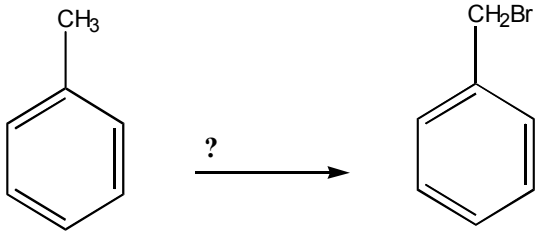
Question 10 (14 marks): Give the major products or fill in the missing reagents for the following reactions:

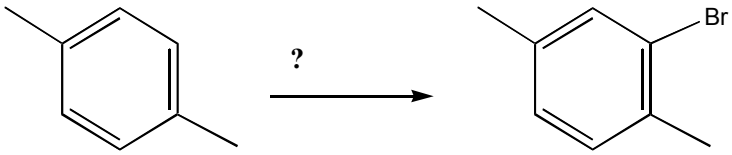
a) 

b) 

c) 

d) 

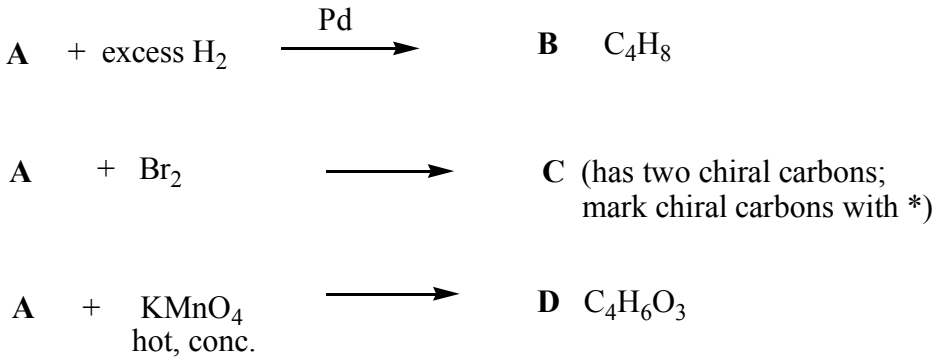
e) 

f) 

Question 11 (8 marks)

Compound **A** has the formula C_4H_6.

The following scheme show what happens when compound **A** reacts with various substances. Give structures for compounds **A-D**.



A	**B**
C	**D**