Name:

Chem 110 Fall 2002 Exam I I I

The Periodic Table

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
H 1 1.01																	He 2 4.00
Li 3 6.94	Be 4 9.01											B 5 10.81	C 6 12.01	N 7 14.01	O 8 16.00	F 9 19.00	Ne 10 20.18
Na 11 22.99	Mg 12 24.31											Al 13 26.98	Si 14 28.09	P 15 30.97	S 16 32.07	Cl 17 35.45	Ar 18 39.95
K 19 39.10	Ca 20 40.08	Sc 21 44.96	Ti 22 47.88	V 23 50.94	Cr 24 52.00	Mn 25 54.94	Fe 26 55.85	Co 27 58.93	Ni 28 58.69	Cu 29 63.55	Zn 30 65.39	Ga 31 69.72	Ge 32 72.61	As 33 74.92	Se 34 78.96	Br 35 79.90	Kr 36 83.80
Rb 37 85.47	Sr 38 87.62	Y 39 88.91	Zr 40 91.22	Nb 41 92.91	Mo 42 95.94	Tc 43 (97.9)	Ru 44 101.07	Rh 45 102.91	Pd 46 106.42	Ag 47 107.87	Cd 48 112.41	In 49 114.82	Sn 50 118.71	Sb 51 121.76	Te 52 127.60	I 53 126.90	Xe 54 131.29
Cs 55 132.91	Ba 56 137.33	La 57 138.91	Hf 72 178.49	Ta 73 180.95	W 74 183.85	Re 75 186.21	Os 76 190.2	Ir 77 192.22	Pt 78 195.08	Au 79 197.97	Hg 80 200.59	Tl 81 204.38	Pb 82 207.2	Bi 83 208.98	Po 84 (209)	At 85 (210)	Rn 86 (222)
Fr 87 223.02	Ra 88 226.03	Ac 89 227.03	Rf 104 (261)	Db 105 (262)	Sg 106 (263)	Bh 107 (262)	Hs 108 (265)	Mt 109 (266)									

Ce 58 140.12	Pr 59 140.91	Nd 60 144.24	Pm 61 (145)	Sm 62 150.36	Eu 63 152.97	Gd 64 157.25	Tb 65 158.93	Dy 66 162.50	Ho 67 164.93	Er 68 167.26	Tm 69 168.93	Yb 70 173.04	Lu 71 174.97
Th 90 232.04	Pa 91 231.04	U 92 238.03	Np 93 237.05	Pu 94 (240)	Am 95 243.06	Cm 96 (247)	Bk 97 (248)	Cf 98 (251)	Es 99 252.08	Fm 100 257.10	Md 101 (257)	No 102 259.10	Lr 103 262.11

Question 1 (9 points)

Using average bond energies the enthalpy change associated with the following reaction:

$$\mathbf{N_2(g) + 3H_2(g) \longrightarrow 2NH_3(aq)}$$

Was determined to be –93 kJ.mol^{-1}. Knowing that the ΔH^0_f of for the elements in their standard state is 0 and ΔH^0_f $NH_3(aq)$ = -80 kJ.mol^{-1}. Using heats of formation data, determine the enthalpy change for the reaction.

Give a simple explanation for the difference in values obtained. Which value do you think is closer to the real value?

Question 2 (24 points)

For each of the following molecules give the **electron-pair** geometry, the **number of lone pairs** around the central atom and the **molecular geometry**.

A. NO_3^-

electron-pair geometry _____

lone pairs _____

molecular geometry _____

B. NO_2^+

electron-pair geometry _____

lone pairs _____

molecular geometry _____

C. NF_3?

electron-pair geometry _____

lone pairs _____

molecular geometry _____

D. CS_2

electron-pair geometry _____

lone pairs _____

molecular geometry _____

Name:

Question 3 (8 points) Classify each of the following molecules as **Polar** or **Non Polar**.

A. NO_3^- _____

B. NO_2^+ _____

C. NF_3 _____

D. CS_2 _____

Do Not Write Here

Question 4 (10 Points) Circle the intermolecular forces that are applicable to the following:

A. The solute-solvent interactions when **calcium chloride** dissolves in water are primarily of the type:

dipole-induced dipole ion-dipole ion-ion dipole-dipole hydrogen bonding

B. The solute-solvent interactions when **O_2** dissolves in water are primarily of the type:

dipole-induced dipole ion-dipole ion-ion dipole-dipole hydrogen bonding

Do Not Write Here

C. The type(s) of intermolecular forces expected between **Cl_2** molecules:

dispersion ion-dipole ion-ion dipole-dipole hydrogen bonding

D. The type(s) of intermolecular forces expected between **HF** molecules:

dispersion ion-dipole ion-ion dipole-dipole hydrogen bonding

Circle the molecule that is expected to have the higher boiling point.

CH_4 CH_3OH CH_3CH_3 CH_3CH_2OH $CH_3CH_3CH_2OH$

Question 5 (5 Points) The equilibrium constant, K_c, for the following reaction is **1.67×10^{-2}** at **1180** K:

$$\mathbf{2\ SO_3}(g) \rightleftharpoons \mathbf{2\ SO_2}(g) + \mathbf{O_2}(g)$$

Calculate K_c at this temperature for:

$$\mathbf{SO_3}(g) \rightleftharpoons \mathbf{SO_2}(g) + \tfrac{1}{2}\ \mathbf{O_2}(g)$$

Do Not Write Here

Question 6 (5 Points)

Consider the following reaction:

$$2\ NO(g) + Br_2(g) \rightleftharpoons 2\ NOBr(g)$$

If **0.580** moles of **NOBr(g)**, **0.567** moles of **NO**, and **0.446** moles of Br_2 are at equilibrium in a **8.8** L container at **452**K, the value of the equilibrium constant

Do Not Write Here

Question 7 (5 Points)

Consider the following system at equilibrium:

$$2\ H_2S(g) + 3\ O_2(g) \rightleftharpoons 2\ H_2O(g) + 2\ SO_2(g)$$

The production of H_2O by this reaction would be favored by:
(Circle those that apply)

Do Not Write Here

A. removing H_2S
B. removing SO_2
C. adding SO_2
D. adding H_2S
E. adding O_2

Question 8 (8 Points)

A. The formula for the **conjugate acid** of CO_3^{2-} is. _____

B. The formula for the **conjugate base** of HPO_4^{2-} is. _____

Do Not Write Here

C. The formula for the **conjugate base** of H_3PO_4 is _____

D. The formula for the **conjugate acid** of NH_3 is _____

Question 9 (8 points)

The $[H_3O^+]$ in an aqueous solution is 5.58×10^{-9} M.

The $[OH^-]$ in the solution is _____ M.

Do Not Write Here

The pH of this solution is _____ and the pOH is _____.

This solution is _____ . (Acidic or Basic)

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Question 10 (5 points) You need to make an aqueous solution of **0.160** M **potassium bromide** for an experiment in lab, using a **500** mL volumetric flask. How much solid **potassium bromide** should you add?

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Question 11 (6 Points) According to the following reaction, how many moles of **bromine trifluoride** are necessary to form **0.387** moles **fluorine gas**?

bromine trifluoride (**g**) ⟶ **bromine** (**g**) + **fluorine** (**g**)

Do Not Write Here

Question 12 (7 points) How many grams of solid **potassium hydroxide** are needed to exactly neutralize **25.1** mL of a **0.642** M **hydrochloric acid** solution ? Assume that the volume remains constant.

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Score:	**Note:**
Do Not Write Here	Do Not Write Here