

Chemistry 12  
Exam II Form A  
February 28, 2001

Name \_\_\_\_\_  
Section \_\_\_\_\_  
Student No. \_\_\_\_\_

**IMPORTANT:** On the scantron (answer sheet), you **MUST** clearly fill your **name**, your **student number**, **section number**, and **test form** (white cover = test form A; yellow cover = test form B). Use a #2 pencil.

University Testing Services  
FORM 5CH91

NAME \_\_\_\_\_  
COURSE \_\_\_\_\_  
DATE \_\_\_\_\_

**FILL IN:**  
Name  
Course  
Date  
Student Number  
Section Number

**CODE:**  
Student Number  
Section Number  
Test Form

USE A NO. 2 PENCIL ONLY.  
MARK ONLY ONE ANSWER FOR EACH ITEM.

STUDENT NUMBER	SEC. NO.	BOOK NO.	SCORE
0 0 0 0 0 0 0 0 0 0	0 0 0	0 0 0 0 0	0 0 0
1 1 1 1 1 1 1 1 1 1	1 1 1	1 1 1 1 1	1 1 1
2 2 2 2 2 2 2 2 2 2	2 2 2	2 2 2 2 2	2 2 2
3 3 3 3 3 3 3 3 3 3	3 3 3	3 3 3 3 3	3 3 3
4 4 4 4 4 4 4 4 4 4	4 4 4	4 4 4 4 4	4 4 4
5 5 5 5 5 5 5 5 5 5	5 5 5	5 5 5 5 5	5 5 5
6 6 6 6 6 6 6 6 6 6	6 6 6	6 6 6 6 6	6 6 6
7 7 7 7 7 7 7 7 7 7	7 7 7	7 7 7 7 7	7 7 7
8 8 8 8 8 8 8 8 8 8	8 8 8	8 8 8 8 8	8 8 8
9 9 9 9 9 9 9 9 9 9	9 9 9	9 9 9 9 9	9 9 9

TEST FORM A B C D E F G H I J  
SPECIAL CODE 1 2 3 4

There are 25 questions on this exam. Check that you have done all of the problems and filled in the first 25 bubbles on the scantron. The maximum score on this exam is 20 points.

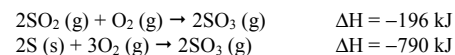
**Exam policy**

- Calculators with text-programmable memory **are not** allowed.
- Relevant data and formulas, including the periodic table, are attached at the end of this exam.
- Your grade will be based only on what is on the scantron form.
- The answer key will be posted on the web after the exam (under "News").

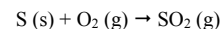
**Hints**

- As you read the question, underline or circle key words to highlight them for yourself. Avoid errors from "mis-reading" the question.
- There is no penalty for guessing.

1. From the following heats of reaction:

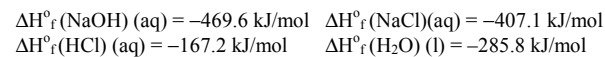


calculate the heat of reaction to form  $\text{SO}_2$  from sulfur and oxygen according to the following equation:



- + 395 kJ
- + 202 kJ
- 297 kJ
- 398 kJ
- 594 kJ

2. Calculate  $\Delta H^\circ_{\text{rxn}}$  for neutralization reaction that occurs between NaOH and HCl.



- +515.5 kJ
- 390.5 kJ
- 1329.7 kJ
- +29.1 kJ
- 56.1 kJ

3. Which of the following is the ground-state electron configuration of  $\text{K}^+$ ?

- $[\text{Ar}]4s^1$
- $[\text{Ar}]3d^{10}$
- $[\text{Ar}]4s^2$
- $[\text{Ar}]$
- $[\text{Ar}]4s^13d^1$

4. How much energy is required to heat 20 g of water from 22 °C to 37 °C? The specific heat of water is 4.18 J/(gK).

- a. 1839 J
  - b. 1254 J
  - c. 3093 J
  - d. 177 J
  - e. 105 J
- 

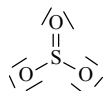
5. How many **unpaired electrons** are there in the ground-state of Cu?

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

6. Which of the following ionic solids has the largest lattice energy?

- a. LiCl
  - b. KCl
  - c. RbCl
  - d. BaO
  - e. SrO
- 

7. A Lewis structure of SO<sub>3</sub> is shown below. How many **additional** resonance structures equivalent to the one shown can be drawn for this molecule?



- a. none
  - b. one
  - c. two
  - d. three
  - e. four
- 

8. The first four ionization energies (I) for an atom are given below.

I<sub>1</sub>: 578      I<sub>2</sub>: 1820      I<sub>3</sub>: 2750      I<sub>4</sub>: 11,600      (all in kJ/mol)

What is the atom represented?

- a. sodium
  - b. aluminum
  - c. chlorine
  - d. silicon
  - e. neon
- 

9. Which of the following atoms is the most electronegative?

- a. francium
  - b. lithium
  - c. chlorine
  - d. oxygen
  - e. fluorine
- 

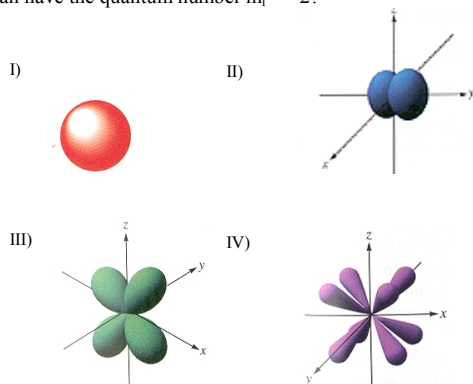
10. Which of the following species has the smallest radius?

- a. Ne
  - b. F<sup>-</sup>
  - c. O<sup>2-</sup>
  - d. Cl
  - e. Cl<sup>-</sup>
- 

11. Which of the following bonds will be non-polar?

- a. Li—H
  - b. H—F
  - c. H—Cl
  - d. O—O
  - e. O—H
-

12. The following pictures present  $s$  (I),  $p$  (II),  $d$  (III), and  $f$  (IV) orbitals. Which of these orbitals can have the quantum number  $m_l = -2$ ?



- III only
- II and III only
- IV only
- III and IV only
- I, II, III and IV

13. Which of the following photons of the electromagnetic radiation has the highest energy?

- orange light with  $\lambda = 645 \text{ nm}$
- radio-wave with frequency of  $700 \text{ MHz}$  ( $\lambda = 43 \text{ cm}$ )
- microwave with  $\lambda = 2 \text{ cm}$
- ultraviolet light with frequency of  $3 \times 10^{15} \text{ s}^{-1}$  ( $\lambda = 100 \text{ nm}$ )
- infrared light with  $\lambda = 6 \text{ }\mu\text{m}$  ( $= 6 \times 10^{-6} \text{ m}$ )

14. Of the following isoelectronic species, which one has the smallest size?

- $\text{S}^{2-}$
- $\text{Cl}^-$
- $\text{Ar}$
- $\text{K}^+$
- $\text{Ca}^{2+}$

15. Which of the following is a **permissible** set of quantum numbers?

	$n$	$l$	$m_l$	$m_s$
a.	2	-1	+2	+1/2
b.	3	2	-3	-1/2
c.	2	-3	-2	-1/2
d.	3	2	-2	+1/2
e.	2	3	0	+1/2

16. Which of the following orderings of atom/ion radii is **incorrect**?

- $\text{I}^- > \text{I} > \text{I}^+$
- $\text{Ca}^{2+} > \text{Mg}^{2+} > \text{Be}^{2+}$
- $\text{Fe} > \text{Fe}^{2+} > \text{Fe}^{3+}$
- $\text{K}^+ > \text{Cl}^- > \text{S}^{2-}$
- $\text{Br} > \text{Cl} > \text{F}$

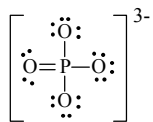
17. Bromine is much more apt to exist as an anion than is potassium. This is because:

- Bromine is bigger than potassium.
- Bromine has greater (more positive) ionization energy than potassium does.
- Bromine has greater (more negative) electron affinity than potassium does.
- Bromine is a gas and potassium is a solid.
- Bromine is more metallic than potassium.

18. Based on the positions of the elements in the periodic table, which of the following bonds is **the most polar**?

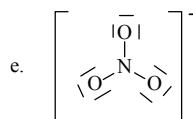
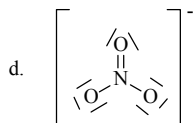
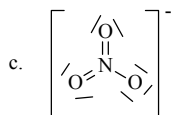
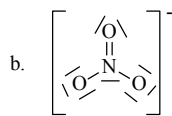
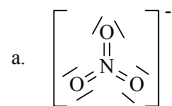
- P—N
- P—O
- P—Si
- P—S
- P—C

19. What is the **formal charge on phosphorus** in the following Lewis structure of  $\text{PO}_4^{3-}$ ?



- a. -2
- b. -1
- c. 0
- d. +1
- e. +2

20. Which of the following drawings is the best Lewis structure for nitrate ion ( $\text{NO}_3^-$ )? Other structures (that are equally good) may exist, but are not shown here.



21. Which of the following statements is **false**?

- a. Metals tend to have lower ionization energies than nonmetals
- b. A neutral element that readily accepts electrons, such as F, has an exothermic electron affinity.
- c. When a neutral atom loses an electron, its radius increases.
- d. Nonmetals are more electronegative than metals.
- e. As one goes across a period from left to right, the radii of the neutral atoms generally decrease.

22. In a given multielectron atom, which subshell electrons experience the largest effective nuclear charge?

- a. 4s
- b. 4p
- c. 4d
- d. 4f
- e. 5s

23. Which quantum number defines the shape of the orbital?

- a. principal ( $n$ )
- b. azimuthal ( $l$ )
- c. magnetic ( $m_l$ )
- d. spin ( $m_s$ )
- e. magnetic and spin ( $m_l$  and  $m_s$ )

24. What is the value of the azimuthal quantum number ( $l$ ) for the outermost electrons in a ground state oxygen atom?

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

25. Which of the following transitions in the Bohr hydrogen atom affords **emission** of the highest-energy photon?

- a.  $n_i = 1 \rightarrow n_f = 4$
- b.  $n_i = 4 \rightarrow n_f = 1$
- c.  $n_i = 4 \rightarrow n_f = 2$
- d.  $n_i = 2 \rightarrow n_f = 4$
- e.  $n_i = 1 \rightarrow n_f = 2$

**END OF EXAM**

## Constants & Equations

$$1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-2}$$

$$R_H = 2.18 \times 10^{-18} \text{ J}$$

$$c = 3.00 \times 10^8 \text{ m} \cdot \text{s}^{-1}$$

$$e = -1.60 \times 10^{-19} \text{ C}$$

$$h = 6.63 \times 10^{-34} \text{ J} \cdot \text{s}$$

$$1 \text{ D} = 3.33 \times 10^{-30} \text{ C} \cdot \text{m}$$

$$N = 6.02 \times 10^{23} \text{ mol}^{-1}$$

$$c = \lambda \nu$$

$$E = h\nu$$

$$\Delta E = R_H \left( \frac{1}{n_i^2} - \frac{1}{n_f^2} \right)$$

$$\lambda = \frac{h}{m\nu}$$

$$\mu = Qr$$

$$E = k_L \frac{Q_1 Q_2}{d}$$

$$q = m \cdot c \cdot \Delta T$$

$$\Delta H^\circ_{\text{rxn}} = \sum n \Delta H^\circ_f(\text{products}) - \sum m \Delta H^\circ_f(\text{reactants})$$

PERIODIC TABLE of the ELEMENTS (2001)

MAIN GROUPS										MAIN GROUPS																									
1A		2A		TRANSITION METALS										3A		4A		5A		6A		7A		8A											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
H 1.008	He 4.003	Li 6.941	Be 9.012	B 10.811	C 12.011	N 14.007	O 15.999	F 18.998	Ne 20.180	Na 22.990	Mg 24.305	Al 26.982	Si 28.086	P 30.974	S 32.066	Cl 35.453	Ar 39.948	K 39.098	Ca 40.078	Sc 44.956	Ti 47.867	V 50.942	Cr 51.996	Mn 54.938	Fe 55.845	Co 58.933	Ni 58.693	Cu 63.546	Zn 65.39	Ga 69.723	Ge 72.61	As 74.992	Se 78.96	Br 79.904	Kr 83.80
Rb 85.468	Sr 87.62	Y 88.906	Zr 91.224	Nb 92.906	Mo 95.94	Tc [98]	Ru 101.07	Rh 102.90	Pd 106.42	Ag 107.87	Cd 112.41	In 114.82	Sn 118.71	Sb 121.76	Te 127.60	I 126.90	Xe 131.29	Cs 132.91	Ba 137.33	La* 138.91	Hf 178.49	Ta 180.95	W 183.84	Re 186.21	Os 190.23	Ir 192.22	Pt 195.08	Au 196.97	Hg 200.59	Tl 204.38	Pb 207.2	Bi 208.98	Po [209]	At [210]	Rn [222]
Fr [223]	Ra [226]	Ac** [227]	Rf [261]	Db [262]	Sg [266]	Bh [264]	Hs [265]	Mt [268]	[269]	[272]	[277]	[285]	[289]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]	[293]
* LANTHANOIDS										** ACTINOIDS																									
Ce 140.12	Pr 140.91	Nd 144.24	Pm [145]	Sm 150.36	Eu 151.96	Gd 157.25	Tb 158.92	Dy 162.50	Ho 164.93	Er 167.26	Tm 168.93	Yb 173.04	Lu 174.97	Th 232.04	Pa 321.04	U 238.03	Np [237]	Pu [244]	Am [243]	Cm [247]	Bk [247]	Cf [251]	Es [252]	Fm [257]	Md [258]	No [259]	Lr [262]	[262]	[262]	[262]	[262]	[262]	[262]		

**ANSWER KEY**  
**Chem 12 Exam II**  
**Spring 2001**

1. C
2. E
3. D
4. B
5. B
6. E
7. C
8. B
9. E
10. A
11. D
12. D
13. D
14. E
15. D
16. D
17. C
18. B
19. C
20. D
21. C
22. A
23. B
24. B
25. B