

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$h = 6.626 \times 10^{-34} \text{ J s}$$

Name: _____

Chemistry 120, Section A
Hour Exam III, November 6, 2006

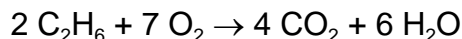
General Instructions: Show *all* of your work for *all* calculation problems and include units on answers where appropriate. Express your final answers in the correct number of significant figures. To speed calculations, round all atomic weights to one decimal place. Draw a box around your final answer.

For the multiple choice questions place the *capital* letter of the *best* answer in the blank to the left of the answer.

1. A nondestructive technique for determining protein concentrations in biochemistry is to determine the absorbance using a wavelength of 280 nm. What is the frequency of this UV light? (5 points)

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{ m/s}}{280 \times 10^{-9} \text{ m}} = 1.07 \times 10^{15} \text{ s}^{-1}$$

2. Use bond energies (attached table) to predict the ΔH for the following properly balanced equation: (5 points)



Average Bond Energies (kJ/mol)

		Single Bonds			Multiple Bonds		
H-H	432	N-H	391	I-I	149	C = C	614
H-F	565	N-N	160	I-Cl	208	C \equiv C	839
H-Cl	427	N-F	272	I-Br	175	O = O	495
H-Br	363	N-Cl	200	S-H	347	C = O*	745
H-I	295	N-Br	243	S-F	327	C \equiv O	1072
C-H	413	N-O	201	S-Cl	253	N = O	607
C-C	347	O-H	467	S-Br	218	N = N	418
C-N	305	O-O	146	S-S	266	N \equiv N	941
C-O	358	O-F	190	Si-Si	340	C \equiv N	891
C-F	485	O-Cl	203	Si-H	393	C = N	615
C-Cl	339	O-I	234	Si-C	360		
C-Br	276	F-F	154	Si-O	452		
C-I	240	F-Cl	253				
C-S	259	F-Br	237				
		Cl-Cl	239				
		Cl-Br	218				
		Br-Br	193				

*C = O(CO₂) = 799

$$[(2)(347) + (12)(413) + (7)(495)] - [(12)(467) + 8(799)] = -2881 \text{ kJ/mol}$$

- 3 Using Chart I, demonstrate whether the following bonds are polar or nonpolar. (4 points)

N-F $3.98 - 3.04 = 0.94$ polar

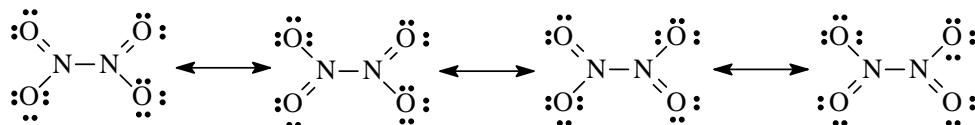
N-S $3.04 - 2.58 = 0.46$ nonpolar

N-O $3.44 - 3.04 = 0.40$ nonpolar

N-N $3.04 - 3.04 = 0$ nonpolar

Chart I. Electronegativities of Selected Elements								
H 2.21								He -
Li 0.98	Be 1.57		B 2.04	C 2.55	N 3.04	O 3.44	F 3.98	Ne -
Na 0.93	Mg 1.31		Al 1.61	Si 1.90	P 2.19	S 2.58	Cl 3.16	Ar -
K 0.82	Ca 1.00		Ga 1.81	Ge 2.01	As 2.18	Se 2.55	Br 2.96	Kr -
Rb 0.82	Sr 0.95		In 1.78	Sn 1.96	Sb 2.05	Te 2.10	I 2.66	Xe -

4. Draw all possible resonance structures of the N_2O_4 molecule. (8 points)



- D 5. Consider the following portion of the energy-level diagram for hydrogen

$$n = 4 \quad -0.1361 \times 10^{-18} \text{ J}$$

$$n = 3 \quad -0.2420 \times 10^{-18} \text{ J}$$

$$n = 2 \quad -0.5445 \times 10^{-18} \text{ J}$$

$$n = 1 \quad -2.178 \times 10^{-18} \text{ J}$$

For which of the following transitions does the light emitted have the *shortest* wavelength?

- A) $n = 2$ to $n = 1$
- B) $n = 3$ to $n = 2$
- C) $n = 4$ to $n = 3$
- D) $n = 4$ to $n = 1$
- E) $n = 4$ to $n = 2$

- D 6. For sodium, the principle quantum number of the *valence* electron is certain to be

- A) 0
- B) 1
- C) 2
- D) 3
- E) 4

- ___D___7. The electron configuration for the barium *atom* is
- A) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
 - B) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
 - C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$
 - D) $[\text{Xe}] 6s^2$
 - E) none of the above
- ___E___8. Rank the elements S, Cl, and F in terms of *increasing* size.
- A) $F < S < Cl$
 - B) $S < F < Cl$
 - C) $S < Cl < F$
 - D) $Cl < F < S$
 - E) $F < Cl < S$
- ___A___9. An alkaline earth metal is
- A) Ca
 - B) Cr
 - C) P
 - D) Rb
 - E) Zn
- ___E___10. The oxidation state of potassium is expected to be
- A) -3
 - B) ± 4
 - C) $+3$
 - D) $+2$
 - E) $+1$
- ___D___11. The type of bond formed between nitrogen and chlorine is
- A) ionic
 - B) polar covalent
 - C) metallic
 - D) nonpolar covalent
 - E) none of the above
- ___E___12. The formula unit for the ionic compound composed of manganese(II) and oxygen is
- A) Mn_2O
 - B) MnO_2
 - C) Mn_2O_3
 - D) Mn_3O_2
 - E) MnO

- ___E___13. Which of the following has the *largest* radius?
- A) Ar
 - B) Cl^-
 - C) K^+
 - D) Rb^+
 - E) S^{2-}
- ___D___14. Which of the following dot formulas is *incorrect*?
- A) PH_3 $\text{H}:\ddot{\text{P}}:\text{H}$
 $\ddot{\text{H}}$
 - B) H_2Se $\text{H}:\ddot{\text{S}}\text{e}:$
 $\ddot{\text{H}}$
 - C) SO_2 $:\ddot{\text{O}}::\ddot{\text{S}}:\ddot{\text{O}}:$
 - D) SCl_2 $\text{Cl}:\ddot{\text{S}}:\text{Cl}$
 - E) all are correct
- ___A___15. Which of the following elements are *likely* to violate the octet rule
- A) B
 - B) C
 - C) N
 - D) O
 - E) more than one correct answer
- ___C___16. What is the formal charge of *carbon* in hydrogen cyanide: $\text{H}-\text{C}\equiv\text{N}:$
- A) - 2
 - B) - 1
 - C) 0
 - D) + 1
 - E) + 2
- ___B___17. Which of the following compounds is *acidic*?
- A) KCl
 - B) CO_2
 - C) Al_2O_3
 - D) Li_2O
 - E) none of the above
- ___B___18. Which of the following *molecules* are *polar*?
- A) CH_4
 - B) CF_2Cl_2
 - C) CO_2
 - D) SO_3
 - E) more than one of the above

- __B__19. Of the following, which are isoelectronic with Kr?
I. S^{2-} II. Sr^{2+} III. K^+ IV. Br^- V. Ar
A) I, II, III
B) II, IV
C) III, IV
D) IV, V
E) none of the above
- __D__20. The *most* likely of the following to react with nitrogen at room temperature would be
A) Li
B) Na
C) K
D) Cs
E) none are likely to react
- __D__21. The total number of electrons which can have $n=4$ is
A) 2
B) 8
C) 16
D) 32
E) 64
- __C__22. Which of the following groups of elements is arranged in order of *increasing* electronegativity?
A) $Si < Al < Br < Cl$
B) $Na < K < Ca < Ba$
C) $P < S < O < F$
D) $K < Rb < Cs < F$
E) $N < P < S < Cl$
- __D__23. An element is a solid, shiny, and silver. It forms the compound XCl_2 . It reacts quickly when exposed to water. The most likely identity of the element is
A) Be
B) Cs
C) Li
D) Sr
E) more information is needed to be confident of the identity
- __B__24. The correct Lewis dot structure for the carbonate PCl_3 has ____ lone pairs of electrons
A) 9
B) 10
C) 18
D) 20
E) none of the above

- __A__25. An element with the electron configuration $[\text{Xe}]6s^25d^7$ would belong to which class on the periodic table?
- A) transition elements
 - B) halogens
 - C) rare earth elements
 - D) alkaline earth elements
 - E) none of the above

- __A__26. Which of the following exhibits the correct orders for *increasing* atomic radius and *increasing* ionization energy, respectively?
- A) F, O, S, and S, O, F
 - B) S, F, O, and S, F, O
 - C) S, O, F, and F, O, S
 - D) F, S, O, and O, S, F
 - E) none of the above

- __A__27. Which of the following diagrams is *correct* for an atom with eight electrons?

- A) $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ \uparrow \uparrow
- B) $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\uparrow$ \uparrow \uparrow
- C) $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ \downarrow \uparrow
- D) $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\underline{\hspace{1cm}}$
- E) none are correct

- __E__28. Which of the following compounds contains *both* ionic and covalent bonds?

- A) Cl_2
- B) HCN
- C) HF
- D) KCl
- E) Na_2SO_4

- __A__29. Which of the following combinations of quantum numbers is *not* allowed?

	n	l	m_l	m_s
A)	1	1	0	$\frac{1}{2}$
B)	2	1	-1	$\frac{1}{2}$
C)	3	0	0	$-\frac{1}{2}$
D)	4	2	0	$\frac{1}{2}$
E)	4	3	-2	$-\frac{1}{2}$

- __E__30. Which of the following gives the correct number of elements in each of the first six periods in the periodic table?

	1 st	2 nd	3 rd	4 th	5 th	6 th period
A)	7	6	4	4	4	4
B)	3	8	8	18	18	18
C)	3	8	8	18	18	32
D)	2	8	8	18	18	18
E)	2	8	8	18	18	32