

Chem 111**2:30p section****Evening Exam #2**

This exam is composed of 25 questions, 1 of which requires mathematics that *might* require a calculator. Go initially through the exam and answer the questions you can answer *quickly*. Then go back and try the ones that are more challenging to you and/or that require calculations.

As discussed in the course syllabus, honesty and integrity are absolute essentials for this class. In fairness to others, dishonest behavior will be dealt with to the full extent of University regulations.

I hereby state that all answers on this exam are my own and that I have neither gained unfairly from others nor have I assisted others in obtaining an unfair advantage on this exam.

Signature

$E = h\nu = \frac{hc}{\lambda}$ $E_n^{H-atom} = -\frac{R_H hc}{n^2}$ $1 \text{ mL} = 1 \text{ cm}^3$	Some common ions: PO_4^{3-} CN^- CH_3CO_2^- NO_2^- NO_3^- CO_3^{2-} SO_3^{2-} SO_4^{2-}	$h = 6.626 \times 10^{-34} \text{ J s}$ $c = 2.9998 \times 10^8 \text{ m s}^{-1}$ $N = 6.022 \times 10^{23} \text{ mol}^{-1}$ $R_H = 1.097 \times 10^7 \text{ m}^{-1}$
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PERIODIC TABLE OF THE ELEMENTS

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1 H 1.008																	2 He 4.003
3 Li 6.939	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (99)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 181.0	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0	89 Ac 227.0	104 Unq (261)	105 Unp (262)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)	1								

1. Which atom or ion below is most paramagnetic?

- 1) Si 2) P 3) S 4) Cl 5) Ar

(2) (OWL question)

2. Which element is represented by: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$

- 1) At 2) Po 3) Te 4) Br 5) I

(4) See p297 to check, but you can read this off the organization of the periodic table.

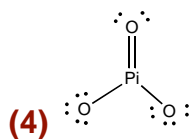
3. Which of the following has the shortest bond length?

- 1) H₂S 2) HCl 3) PH₃ 4) AlH₃ 5) SiH₄

(2) Cl is smallest of S, Al, Cl, Si, and P. This allows H and Cl to approach closest, given that all are *single* bonds.

4. Consider the molecule PO₃^x, where x is the charge on the molecule. Two bonds are single bonds, one is a double bond. Which value of x yields the stable molecule? (Hint: draw Lewis structures to figure this one out)

- 1) -4 2) -3 3) -2 4) -1 5) 0



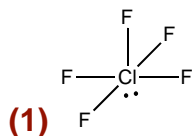
5. For the PO₃^x molecule above, how many equal-energy resonance structures can you draw?

- 1) 1 2) 2 3) 3 4) 4 5) 6

(3)

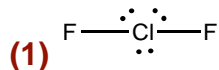
6. Consider the molecule ClF₅ How many lone pairs are on the central atom?

- 1) 1 2) 2 3) 3 4) 4 5) 0



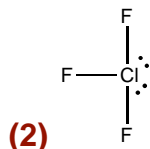
7. Consider the molecule ClF_2^- What is the electron pair geometry?

- 1) Trigonal bipyramidal 2) Octahedral 3) linear
4) Trigonal planer 5) Tetrahedral



8. Consider the molecule ClF_3 What is the molecular geometry?

- 1) Trigonal bipyramidal 2) T-shaped 3) Octahedral
4) Trigonal planer 5) Tetrahedral



9. Which of the following has the longest bond length?

- 1) CF_4 2) CCl_4 3) CBr_4 4) CI_4 5) None

(4) I is largest of F, Cl, Br, I OWL 9-xx

10. Which of the following has the lowest bond energy?

- 1) SiF_4 2) SiCl_4 3) SiBr_4 4) SiI_4 5) None

(4) – longest bond, weakest bond OWL 9-xx

11. Which of the following has the shortest bond length?

- 1) B_2 2) C_2 3) N_2 4) O_2 5) F_2

(3) N_2 – triple bond OWL 9-xx

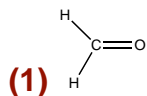
12. The electron pair geometry centered at the O atom in CH_3COCH_3 is:

- 1) Trigonal planar 2) Tetrahedral 3) linear
4) Trigonal bipyramidal 5) Octahedral

(1) Tetrahedral

13. In the molecule **formaldehyde** CH_2O , what is the approximate HCO bond angle?

- 1) 120° 2) 109° 3) 90° 4) 180° 5) 60°



- trigonal planar at the C

14. What is the molecular geometry of SF₄?

- 1) trigonal bipyramidal 2) Octahedral 3) Seesaw
4) trigonal pyramidal 5) square pyramidal

(3) - See Figure 9.11

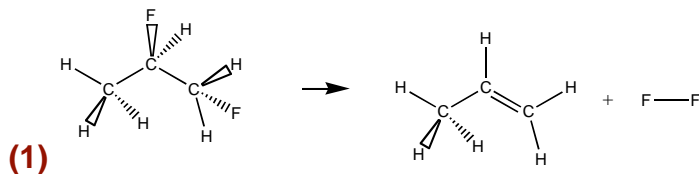
Bond Dissociation Energies (kJ mol⁻¹) (gas phase)

Bond	D	Bond	D	Bond	D
H-H	436	C-C	346	N-N	163
C-H	413	C=C	610	N=N	418
N-H	391	O-O	146	C-O	358
O-H	463	O=O	498	C=O	745
C-F	485	F-F	155		

15. Consider the reaction: CH₃(CFH)(CH₂F) (g) → CH₃CHCH₂ (g) + F₂ (g)

What is the energy (ΔH°, in kJ mol⁻¹) for this reaction?

- 1) +551 2) +220 3) -126 4) -205 5) -220



ΔH° = (Bonds Broken) – (Bonds Formed)

$$\Delta H^\circ = [(2D_{\text{C-F}}) + D_{\text{C-C}}] - (D_{\text{C=C}} + D_{\text{F-F}}) = 2(485) + 346 - (610 + 155) = +551 \text{ kJ mol}^{-1}$$

16. Which of the following has the highest effective nuclear charge as seen by its outermost valence electrons?

- 1) Br 2) N 3) S 4) F 5) Ne

(5) Ne

17. Which of the following has the highest effective nuclear charge as seen by its outermost valence electrons?

- 1) Cl⁻ 2) Ar 3) K 4) Ar⁻ 5) K⁺

(5) K⁺ Cl⁻, Ar, and K⁺ are isoelectronic, 3p valence electrons

18. Which of the following has the lowest electron affinity?

- 1) Cl 2) S 3) P 4) Si 5) Al

(5)

19. From which species below is it hardest to remove an electron?

- 1) Mg^{2+} 2) Na^+ 3) Ne 4) F^- 5) O^{2-}

(1)

20. Which ion has the smallest radius?

- 1) In^{3+} 2) Cs^+ 3) Al^{3+} 4) Ca^{2+} 5) Tl^{3+}

(3)

21. What is the formal charge on Cl in $\left[\text{:}\ddot{\text{S}}\text{---}\ddot{\text{C}}\text{=}\ddot{\text{Cl}}\text{:} \right]$?

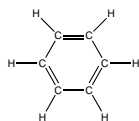
- 1) -2 2) -1 3) 0 4) +1 5) +2

(4)

22. What is the overall charge on the species $\left[\text{:}\ddot{\text{S}}\text{---}\ddot{\text{C}}\text{=}\ddot{\text{Cl}}\text{:} \right]$?

- 1) -2 2) -1 3) 0 4) +1 5) +2

(2)



23. Consider benzene in all of its resonance forms. What is the C-C bond order?

- 1) 2.5 2) 2.0 3) 1.5 4) 1.0 5) 0.5

(3)

24. Which of the following molecules is most polar?

- 1) CBr_4 2) CBr_3H 3) CH_4 4) CF_3H 5) CF_4

(4)

25. What is the catalog number for this class?

- 1) 222 2) 123 3) 3.14159 4) 111 5) 68.6 g

(4)