

Exam 3 Chm 203 (Dr Mattson) 8 November 2012

Academic Integrity Pledge: *In keeping with Creighton University's ideals and with the Academic Integrity Code, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.*

Signature:

Instructions: Show all work whenever a calculation box is provided! Write legibly. Include units whenever appropriate. **BOX YOUR ANSWERS!** You will receive credit for how you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in the answer box and then attach the periodic table. At your desk you are allowed only pencils (but no pencil pouch), an eraser, and a non-programmable calculator without a slipcover. Backpacks and purses must be stored in the front of the room. Cell phones must be OFF and placed at the front of the room.

1. (3 pts) Circle the largest atom in each set

- A. Be C O
B. B Ga In
C. W Ru Ni

2. (3 pts) Which atom has the largest first ionization energy in each set?

- A. Be C O
B. B Ga In
C. W Ru Ni

3. (3 pts) Write the ground state electronic configuration for these ions. **Do not use core notation: start with 1s...**

A.	P ⁻³
B.	Mg ⁺²
C.	Fe ⁺³

4. (1 pt) Which atom has the largest 3rd ionization energy?

Ca V Co Zn Se

5. (1 pt) Which member has the largest ionization energy?

V V⁺² V⁺³ V⁺⁴

6. (3 pts) Which member of each pair is the smallest?

- A. K K⁺
B. K⁺ Ca⁺²
C. F F⁻

7. (3 pts) Which member of each set has the largest electron affinity?

- A. Be C O
B. Zn Ge Kr
C. Na Mg Al

8. (3 pts) Which member of each set has the largest electronegativity?

- A. O F Ne
B. O S Se
C. Ge S Ne

9. (2 pts) Which bond is the most polar?

- A. B-N C-F O-O F-F
B. B-N B-C B-O B-F

10. (3 pts) Which member of each pair has the largest lattice energy?

- a. LiCl or Na₂O b. MgO or MgCl₂
c. magnesium oxide or sodium oxide

11. (12 pts) Predict the ABE formula and shape of each of these molecules. The first atom is the central atom, A.

SnCl ₄	oxygen dichloride
ABE:	ABE:
Shape:	Shape:
CBrN	SeO ₂
ABE:	ABE:
Shape:	Shape:
PH ₃	sulfur trioxide
ABE:	ABE:
Shape:	Shape:

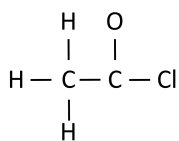
12. (8 pts) Sketch the Lewis dot structures of these polyatomic ions. The first atom is the central atom, A.

PCl ₄ ⁺	CNO ⁻
CH ₃ ⁻	nitrate

13. (3 pts) The nitrate ion has resonance forms. Sketch all resonance forms.

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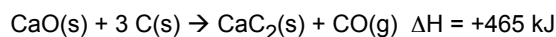
14. The molecule CH₃COCl is shown at right. 14a. (2 pts) Fix the drawing so that every atom has an octet (or duplet), and then answer these questions:



- 14b. (1 pt) What is the hybridization on the left C atom?
- 14c. (1 pt) What is the hybridization on the right C atom?
- 14d. (1 pt) What is the hybridization on the oxygen atom?
- 14e. (2 pts) How many σ and π bonds are present in the molecule?

Answer: _____ σ and _____ π bonds are present

15. Calcium carbide, CaC₂ (MM = 64.1 g/mol) is made from calcium oxide (MM = 56.1 g/mol) and carbon:



- 15a. (1 pt) The reaction is (**exothermic** or **endothermic**).
- 15b. (4 pts) How much heat is needed if 500.0 g CaO is used with excess carbon?

15c. (4 pts) What is the enthalpy change if 10.0 g CaO(s) and 5.0 g C(s) are used in the reaction?

15d. (2 pts) What is ΔH for the reaction:
 $\text{CaC}_2\text{(s)} + \text{CO(g)} \rightarrow \text{CaO(s)} + 3 \text{C(s)} \quad \Delta H = \underline{\hspace{2cm}}$

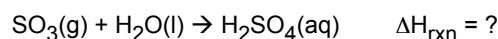
16. (2 pts) Given: $2 \text{NO(g)} \rightarrow \text{N}_2\text{(g)} + \text{O}_2\text{(g)} \quad \Delta H^\circ = -180 \text{ kJ}$, what is the molar heat of formation, ΔH_f° , for NO(g), in kJ/mol NO?

17. Suppose 2.15 g SO₃ (MM = 80.0 g/mol) were added to 50.0 g water in a coffee cup calorimeter. The solution warms up from 20.7 °C to 48.7 °C.

17a. (3 pts) Assuming the specific heat of the solution is 4.184 J/g deg, calculate q_{cal} .

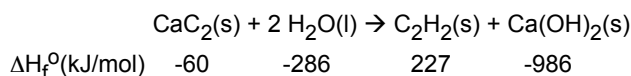
17b. (1 pt) What is q_{rxn} ?

17c. (3 pts) The reaction that took place is:



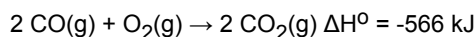
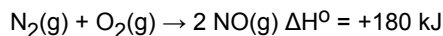
Calculate ΔH_{rxn} for this reaction.

18. (4 pts) The calcium carbide produced in the above reaction is used to make acetylene, C₂H₂:

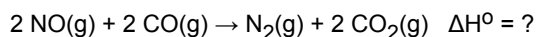


Use the ΔH_f° values given below each compound to calculate ΔH° for the reaction.

19. (3 pts) Given the two reactions:



Use Hess's law to calculate ΔH° for the reaction:



For DocM to complete:

Subtotal from exam: _____

Folder work: (20 max) _____

Total: _____

Answers:

19. $\Delta H^\circ = -746 \text{ kJ}$

1. A. Be; B. In; C. W

2. A. O; B. B; C. Ni

3. A. $1s^2 2s^2 2p^6 3s^2 3p^6$; B. $1s^2 2s^2 2p^6$; C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^0 3d^5$

4. Ca; 5. V^{+4}

6. A. K^+ ; B. Ca^{+2} ; C. F

7. A. O; B. Ge; C. Al

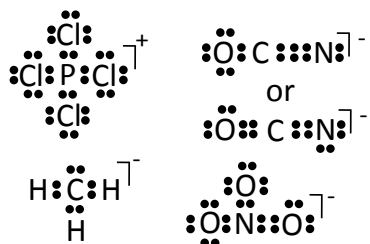
8. A. F; B. O; C. S

9. A. C-F; B. B-F

10. a. Na_2O ; b. MgO ; c. magnesium oxide

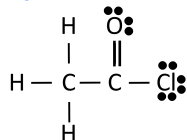
11. $SnCl_4$: ABE: AB_4 ; Shape: tetrahedral
oxygen dichloride; ABE: AB_2E_2 ; Shape: bent
 $CBrN$; ABE: AB_2 ; Shape: linear
 SeO_2 ; ABE: AB_2E ; Shape: bent
 PH_3 ; ABE: AB_3E ; Shape: trigonal pyramid
sulfur trioxide; ABE: AB_3 ; Shape: trigonal plane

12.



13. Two more sketches like the one at the lower right above, but with the double bond going to each of the other oxygen atoms.

14a.



14b. sp^3 ; 14c. sp^2 ; 14d. sp^2 ; 14e. 6 σ and 1 π bonds

15a. **endothermic**; 15b. $q = 4140 \text{ kJ}$; 15c. 64.5 kJ ; 15d. $\Delta H = -465 \text{ kJ}$

16. $\Delta H_f^\circ = +90 \text{ kJ/mol NO?}$

17a. $q_{cal} = 6109 \text{ J}$; 17b. $q_{rxn} = -6109 \text{ J}$; 17c. $\Delta H_{rxn} = -227 \text{ kJ}$

18. $\Delta H^\circ = -127 \text{ kJ}$