

Selected Answers to the JAC NYA Winter 2009 Final Exam

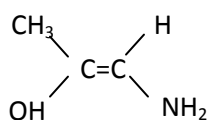
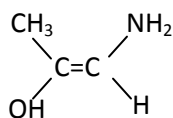
1.
 2. a) $n_{\text{initial}} = 6$; b) $\lambda = 4055\text{nm} = 4060\text{nm}$.
 3. He+
 4. 216 kJ/mol
 5. photoelectric effect
 6. C and B⁻; Mn²⁺ and Fe³⁺; Zn and Ge²⁺
 7. 4d, (-2-1 0 1 2), (0 1 2 3), 3, 4, l, 3, orientation.
 8. K (para), copper (para), oxide (dia), Mn²⁺(para)
 9. Cr⁴⁺
 10. a) Sc³⁺; Ca²⁺, Cl⁻ (Cl⁻ largest); b) Sr, Mg, Ar (Ar has the largest IE)
 11. a).....; b) RbI, LiI, CaO (highest)
 12. a)..... ; b) +5532 kJ/mol (breaking lattice is positive);
 13. Assuming that the lattice energy of AlI₄ is similar to that of AlI₃, we can say that the main reason is the very large 4th ionization energy of aluminum. This large IE₄ will cause the whole Born Haber cycle to be endothermic, and the meaning of that is that the resulted compound is less stable than its elements in the standard state. In other words: No driving force for the formation of this compound.
 14. seesaw (2nd from the left).
 15. a) SO₂ polar; b) CO₂ non-polar
 16. $\Delta H_{\text{rxn}} = -147 \text{ kJ/mol}$
 17. best structure:
$$\begin{array}{c} \text{H} \\ \diagdown \\ \text{C} = \text{N} = \text{N} \\ \diagup \\ \text{H} \end{array}$$
- Note that there are two lone pairs on the terminal nitrogen. (In your answer you must include them).
- Formal charge on central N is +1 and on terminal N is -1.
18.hybridization of the two carbon atoms is sp² and of the oxygen atom is sp³.

19.

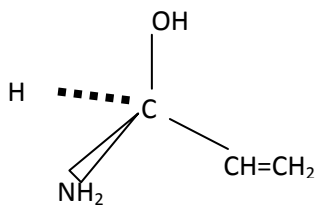
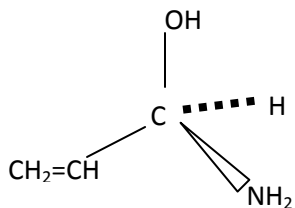
	3D representation * (= electronic arrangement)	Bond angles	Name of molecular geometry
HArF	Trigonal bipyramidal (all 3 lone pairs on equatorial position)	HArF = 180	linear
ONF	Trigonal planar	ONF < 120	bent
ICl₄⁻	octahedral	ClICl = 90	Square planar

*Note that you were required to draw.

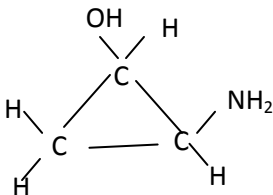
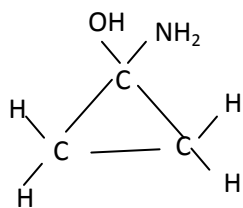
20.a. diastereomers (=geometrical isomers):



b. enantiomers (=optical isomers):



c. structural/constitutional isomers:



21. N-O bond in NO_2^- is longer than in NO^- .
22. BE of $\text{C}\equiv\text{N}$ is 891kJ/mol.
23. lowest to highest boiling point: $\text{CH}_3\text{CH}_2\text{CH}_3 < \text{CH}_3\text{OCH}_3 < \text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3 < \text{CH}_3\text{CH}_2\text{OH}$
24. a) i. A ii. B iii. D iv. B v. A
b) D
25. H-bond
26. CH_3^- is the stronger base. (it is less stable than OH^- b/c.....)
27. metal, molecular solid, ionic solid.
28. 3,1,2,4 where 1 represents the strongest acid (=lowest pK_a).
29. a) imperfectly insulated container, reaction not instantaneous, incomplete reaction, etc.
b) 14.6 °C
c) 27 kJ/mol