1. The ionic compound with the highest lattice energy is:
   (a) Li₂S
   (b) Cs₂S
   (c) CaSe
   (d) MgO
   (e) Na₂Te

2. Average bond energies for the following bonds are:
   - N-H 391 kJ/mol
   - H-H 432 kJ/mol
   - N-N 160 kJ/mol
   - N=N 418 kJ/mol
   - N≡N 945 kJ/mol

   What is $\Delta H_{\text{rxn}}^\circ$ of the reaction represented by the following equation?
   $$\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightarrow 2 \text{NH}_3(\text{g})$$
   (a) -105 kJ
   (b) -890 kJ
   (c) 986 kJ
   (d) 4587 kJ
   (e) 3582 kJ

3. Which of these statements is true for C₂H₄ and CH₃CN?
   (a) It will take more energy to break a C₂H₄ molecule into individual atoms than to break a CH₃CN molecule into individual atoms.
   (b) It will take more energy to break a CH₃CN molecule into individual atoms than to break a C₂H₄ molecule into individual atoms.
   (c) It will take an equal amount of energy to break these two molecules into their individual atoms.
   (d) There is not enough information given to answer this question.

4. What is the molecular shape of a ClF₄⁺ ion with the Lewis structure shown?

   ![Lewis structure](image)
   (a) Tetrahedral
   (b) Trigonal Pyramidal
   (c) Trigonal Planar
   (d) Square Planar
   (e) See Saw
5. The Br–Br–Br bond angle in the Br\textsubscript{3}\textsuperscript{−} ion is:

(a) 120°
(b) 180°
(c) 90°
(d) slightly less than 120°
(e) 109.5°

6. What are the O–N–O bond angles in the NO\textsubscript{3}\textsuperscript{−} ion?

(a) All equal 120°.
(b) All equal 109.5°.
(c) All are greater than 120°.
(d) Two are greater than 120° one is less than 120°.
(e) Two are less than 120° one is greater than 120°.

7. Which of the following molecules has the carbon-carbon bond that absorbs at the shortest wavelength in the infrared?

(a) I
(b) II
(c) III
(d) All three carbon-carbon bonds absorb the same wavelength.
(e) The answer cannot be determined from the information given.
8. Where are attractive forces larger than repulsive forces?

(a) between 150 pm and 180 pm  
(b) at 210 pm  
(c) between 240 pm and 320 pm  
(d) at 150 pm  
(e) between 120 pm and 150 pm

9. Which bond has the highest bond order?

(a) A  
(b) B  
(c) D  
(d) E  
(e) F
10. Which bond is the longest?
   (a) A
   (b) B
   (c) D
   (d) E
   (e) F

11. Which label indicates a carbonyl group?
   (a) A
   (b) B
   (c) D
   (d) E
   (e) G

12. Which of these rings is present in the molecule?
   (a) cyclopropene
   (b) cyclobutane
   (c) cyclopentene
   (d) cyclohexane
   (e) cycloheptene

13. How many hydrogen atoms are bonded to the carbon labeled C?
   (a) 0
   (b) 1
   (c) 2
   (d) 3
   (e) 4
14. The absorption of octadecylbenzene in the region below 1000 nm is shown in the spectrum below:

![Graph showing absorption spectrum](http://webbook.nist.gov/chemistry)

What color is a sample of octadecylbenzene?

(a) Red
(b) Yellow
(c) Green
(d) Purple
(e) Colorless

15. Xenon, Xe, is about 25 times more soluble than helium, He, in water. The best explanation for this is:

(a) Xe is a larger atom than He.
(b) Xe is more polarizable than He.
(c) Xe forms diatomic molecules, He does not.
(d) He liquefies at a lower temperature than Xe.
(e) the molar mass of Xe is about 25 times that of He.

16. Which is the most polar single bond?

(a) C-F
(b) C-O
(c) C-Cl
(d) Si-N
(e) Si-F
17. Which has the strongest intermolecular force?

(a) \( \text{I} - \text{Cl} \cdots \cdots \text{I} - \text{Cl} \)
(b) \( \text{H} - \text{Cl} \cdots \cdots \text{Cl} - \text{Cl} \)
(c) \( \text{O} - \text{H} \cdots \cdots \text{O} - \text{H} \)

(d) \( \text{Na}^+ \cdots \cdots \text{O} - \text{H} \)
(e) \( \text{F} - \text{F} \cdots \cdots \text{F} - \text{F} \)

18. Which lists the molecules in increasing order of their dipole moments?

(a) \( \text{NF}_3 < \text{PF}_3 < \text{BF}_3 \)
(b) \( \text{BF}_3 = \text{NF}_3 < \text{PF}_3 \)
(c) \( \text{BF}_3 < \text{PF}_3 < \text{NF}_3 \)
(d) \( \text{BF}_3 < \text{NF}_3 < \text{PF}_3 \)
(e) \( \text{PF}_3 = \text{BF}_3 < \text{NF}_3 \)

19. The best representation for sodium chloride dissolved in water is:

(a)

(b)

(c)

(d)
20. A standard curve for the concentration of an iron sample is shown in the following figure. For this curve, \( y = 0.115 \times + 0.179 \).

If the absorbance of an unknown is 0.50, what is the concentration of iron in the unknown?

(a) 0.50 M  
(b) 2.4 M  
(c) 2.4 mg/L  
(d) 2.8 M  
(e) 2.8 mg/L

- END OF EXAM -

Before you turn in your scan sheet, be sure you have the following information coded correctly on your scan sheet:

- Your name
- Your PUID number
- Your 4-digit section number
- The test number printed on the cover sheet in the upper right-hand corner.

Answers to the exam questions will be posted on the CHM 115 website sometime tomorrow morning (Tuesday, Oct 24), hopefully between 10 AM and Noon.