1. Select the true statement from below.
(1) SiO\textsubscript{2} exhibits more covalent character than does CO\textsubscript{2}
(2) AlCl\textsubscript{3} exhibits more ionic character than does NaCl
(3) elements from Group 7A are strong oxidizing agents
(4) metals conduct heat and electricity because their valence electrons are very localized (rigidly held in place)
(5) electronegativity is a measure of enthalpy change and therefore the units of electronegativity are kJ/mol

2. Of the compounds below, which exhibits the most ionic character?
(1) AlN (2) NBr\textsubscript{3} (3) AlBr\textsubscript{3} (4) NO\textsubscript{2} (5) Al\textsubscript{2}O\textsubscript{3}

3. Predict which of the following covalent bonds is the most polar.
(1) P—O (2) S—Cl (3) C—H (4) N—S (5) O—F

4. In Pennsylvania and other northern states, salt is put on the ice to prevent black ice on the roads. Why does the ice melt when salt (NaCl) touches it?
   1) The energy in salt heats up the ice
   2) The melting point of ice increases due to the colligative properties of NaCl
   3) The freezing point of the ice decreases due to the colligative properties
   4) The ionic – dipole bonds increase the bond energy which results in heat
   5) None of the Above

5. Which member in each pair has the highest vapor pressure at a given temperature?
   A: C\textsubscript{2}H\textsubscript{6} or C\textsubscript{4}H\textsubscript{10}  B: CH\textsubscript{3}CH\textsubscript{2}OH or CH\textsubscript{3}CH\textsubscript{2}F  C: NH\textsubscript{3} or PH\textsubscript{3}
   1) C\textsubscript{2}H\textsubscript{6}, CH\textsubscript{3}CH\textsubscript{2}OH, NH\textsubscript{3}
   2) C\textsubscript{2}H\textsubscript{6}, CH\textsubscript{3}CH\textsubscript{2}F, PH\textsubscript{3}
   3) C\textsubscript{4}H\textsubscript{10}, CH\textsubscript{3}CH\textsubscript{2}F, PH\textsubscript{3}
   4) C\textsubscript{2}H\textsubscript{6}, CH\textsubscript{3}CH\textsubscript{2}F, NH\textsubscript{3}
   5) C\textsubscript{4}H\textsubscript{10}, CH\textsubscript{3}CH\textsubscript{2}OH, NH\textsubscript{3}

6. Nickel crystallizes in a face-centered cubic structure with an edge length a = 352.4 pm. Based on this information, calculate the approximate density of nickel.
   1) 8.9  2) 2.4  3) 9.3  4) 8.7  5) 7.6

7. Copper adopts a face centered cubic cell, and the edge length of the unit cell is 361.5 pm. What is the atomic radius of copper?
   1) 127.8 pm
   2) 255.6 pm
   3) 511.2 pm
   4) 383.4 pm
   5) None of the above
8. Which of the following is true?
   1) Ion – Dipole forces are not as strong as ion – induced dipole
   2) Hydrogen bonding is the principal force in polar solutions
   3) Dispersion forces only contribute to solubility in nonpolar solutions
   4) Ion – Dipole forces in aqueous solutions result in ions clustering around water. These are called hydration shells
   5) All of the above are true

9. Which of the following is not true?
   1) 0.12 \( m \) Na\(_2\)SO\(_4\) has a higher boiling point than 0.12 \( m \) KBr
   2) 0.10 \( m \) CaCl\(_2\) has a lower freezing point than 0.20 \( m \) HOCH\(_2\)CH\(_2\)OH
   3) According to the phase diagram, the solid has a lower density than the liquid.
   4) According to the phase diagram, the temperature corresponding to Point E is the normal boiling point.
   5) All of the following are true.

10. A sample of rubbing alcohol contains 142 g of isopropyl alcohol (C\(_3\)H\(_7\)OH) and 58.0 g of water. What are the mole fractions of alcohol and water respectively?
   1) 0.423, 0.423
   2) 0.500, 0.500
   3) 0.577, 0.423
   4) 0.423, 0.577
   5) None of the Above

11. Use the following information on Cr to determine the amounts of heat for the three heating steps required to convert 135.8 g of solid Cr at 1760\(^\circ\)C into liquid Cr at 2060\(^\circ\)C. Melting Point: 1860\(^\circ\)C
    Boiling Point: 2672\(^\circ\)C
    \( \Delta H_{\text{fus}} \): 20.5 \( \text{kJ/mol} \)
    \( \Delta H_{\text{vap}} \): 339 \( \text{kJ/mol} \)
    c(solid): 44.8 \( \text{J/g}^\circ\text{C} \)
    c(liquid): 0.94 \( \text{J/g}^\circ\text{C} \)
   1) 687 \( \text{kJ} \)
   2) 657 \( \text{kJ} \)
   3) 332 \( \text{kJ} \)
   4) 553 \( \text{kJ} \)
   5) 85 \( \text{kJ} \)
12. If the van’t Hoff factor for NaCl is experimentally determined to be 1.84, what is the freezing point of a 0.86 molal NaCl solution in water? (Water’s Kf=1.86°C/m)

13. Consider the following vapor pressure curve diagram. Identify which of the curves correspond to HF, HCl, and HBr. What is the approximate normal boiling point of HCl?

(1) 20°C (2) 40°C (3) 60°C (4) 80°C (5) 100°C

14. Rank these aqueous solutions from lowest freezing point to highest freezing point.

0.20 m Na3PO4, 0.30 m KNO3, 0.10 m C6H12O6

(1) 0.10 m C6H12O6 < 0.20 m Na3PO4 < 0.30 m KNO3

(2) 0.30 m KNO3 < 0.20 m Na3PO4 < 0.10 m C6H12O6

(3) 0.20 m Na3PO4 < 0.30 m KNO3 < 0.10 m C6H12O6

(4) 0.10 m C6H12O6 < 0.30 m KNO3 < 0.20 m Na3PO4

(5) 0.20 m Na3PO4 < 0.10 m C6H12O6 < 0.30 m KNO3
15. Which of the following statements regarding an aqueous 1 M sucrose solution is not correct?

(1) The boiling point is greater than 100 oC.

(2) The freezing point is lower than that of an aqueous 1 M NaCl solution.

(3) The freezing point is less than 0.0 oC.

(4) The boiling point is lower than that of an aqueous 1 M NaCl solution.

(5) The vapor pressure at 100 oC is less than 760 torr.