



g) Looking at the information given above, find one example of a nonpolar compound. Explain why it is nonpolar. Be sure to discuss the polarity of bonds and the overall shape/symmetry of the molecule.

h) At room temperature (72 °F) propane is a gas and water is a liquid. This means that 72 °F must be higher than the boiling point for propane, but lower than the boiling point for water. Explain why propane has a lower boiling point than water. Provide an analysis of the interparticle forces between two molecules of propane and interparticle forces between two molecules of water and use these analyses to support your answer.

2. Aluminum chloride is frequently used as an active ingredient in antiperspirants. It reacts with particular components in sweat to form a gel plug in the duct of the sweat gland. The plugs prevent sweat from reaching the surface of the skin.

a) Is aluminum chloride an ionic or covalent compound? How does the [ionic or covalent, depending on what you selected] bond form?

a) Draw the Bohr model for an aluminum atom. Show the number of protons and electrons and show where they are found in the atom.

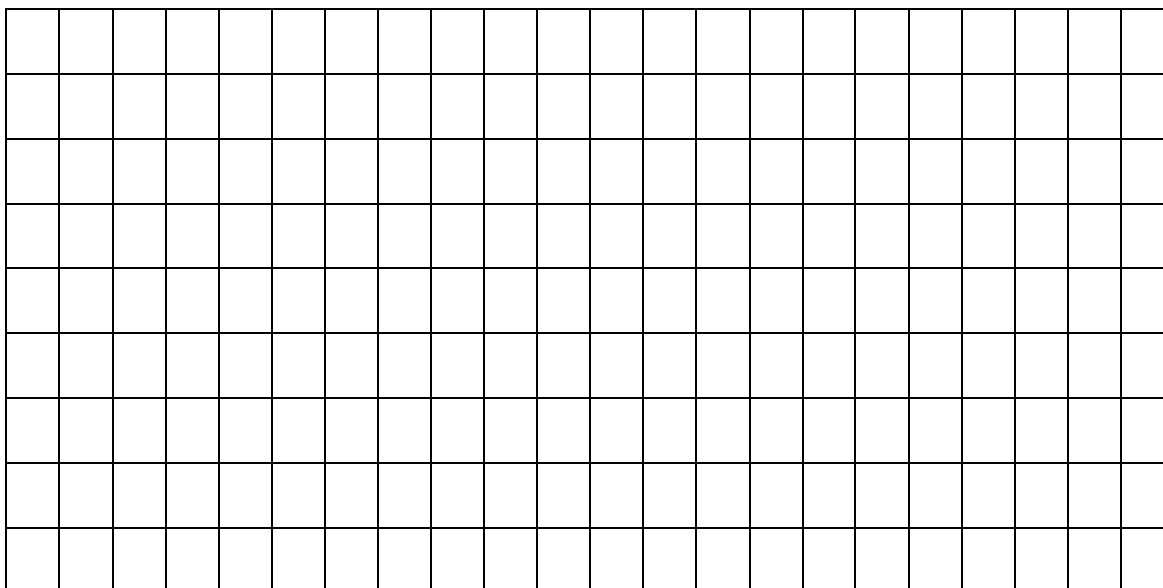
- b) How many valence electrons does an aluminum atom have?
- c) What ion will aluminum form (provide the charge) and WHY will this ion form? Explain the chemical rationale for why an atom would form an ion.
- d) Write the chemical formula of aluminum chloride. Explain the ratio in which aluminum and chlorine atoms form a chemical compound.
- e) Draw the Bohr model for the chloride ION and determine the charge on the chloride ion. Show the number of protons and electrons and show where they are found in the ion.
- f) Write a procedure in a numbered list for how you would make 300ml of a 7% (mass/volume) aluminum chloride solution. Show all calculations.

- g) If you have already prepared this 7% (mass/volume) aluminum chloride solution, how could you dilute it to make 0.5 L of a 2% solution? Show your work.
- h) Write an experimental procedure in a numbered list form for this dilution.
- i) Which solution of aluminum chloride is more concentrated 7% or 7M? Explain your reasoning and show all calculations.

3. A solution of the permanganate ion is purple. Because of this, the concentration of permanganate ion is often determined by measuring its absorbance of light. The absorbance data below were determined for known concentrations of permanganate ion.

<u>Concentration (mmoles/L)</u>	<u>Absorbance (no units)</u>
0.00	0.00
0.15	0.72
0.23	1.21
0.35	1.76
0.45	2.28

a) Using the above information, make a graph representing this data. Draw a line of best fit.



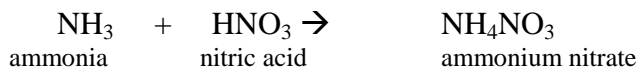
b) Make observations and draw a generalization about the relationship between the absorbance and concentration. Is this relationship linear or nonlinear? Is this relationship direct or inverse?

c) Using your line of best fit, create a prediction for concentration of permanganate ion in a solution whose absorbance is 1.50. Use the graph to support your prediction.

4. The density of carbon in the form of diamond is  $3.52 \text{ g/cm}^3$ . Graphite is another modification (allotrope) of carbon and it has density of  $2.67 \text{ g/cm}^3$ . What does it tell you about the arrangement of carbon atoms in diamond vs graphite?

If you take 5 mg samples of each carbon allotrope, which one would have higher volume? Create a hypothesis about which allotrope of carbon has higher volume and then test your hypothesis using mathematical calculations and reasoning. Show all your work.

5. Large quantities of fertilizer are washed into the Mississippi River from agricultural land in the midwest. The excess nutrients collect in the Gulf of Mexico, promoting the growth of algae and endangering other aquatic life. One commonly used fertilizer is ammonium nitrate,  $\text{NH}_4\text{NO}_3$ . Corn farmers typically use  $5.0 \times 10^3 \text{ kg}$  of ammonium nitrate per square kilometer of cornfield per year. Ammonium Nitrate can be prepared by the following reaction:



- a) How many grams of ammonium nitrate per square kilometer are used by corn farmers in a year? Show all calculations.
  
  
  
  
  
  
  
  
  
  
- b) How many moles of ammonium nitrate per square kilometer are used in a year? Show all calculations, units, significant figures, scientific notation if applicable, and units' cancellation.

- c) Using the moles of ammonium nitrate used in a year and balanced equation; find how many moles of nitric acid are used for production of ammonium nitrate? Show all calculations, units, significant figures, scientific notation if applicable, and units' cancellation.
- d) How many kilograms of nitric acid would be required to make the fertilizer needed for  $1\text{km}^2$  of cornfield per year? Show all calculations, units, significant figures, scientific notation if applicable, and units' cancellation.