1. What is the oxidation number of S8? 0
2. What is the maximum + and - oxidation #s of the following Se +6, -2, Sn +4, -4, As +5, -3, C +4, -4, B +3, -5, N +5, -3. For representative elements the group number is the maximum positive ox. #. Eight minus the group number is the maximum negative ox. #. See Figure 4.12, page 152.
3. Determine the oxidation # of N in HNO2 +3
4. Which of the following could have an oxidation # of +1 based on Group #:
   Li
5. Put the oxidation number for one atom of the element in the box provided.
   \[ \begin{align*}
   +1 &+5 -2 \\
   H_2PO_4 & \\
   +1 &+3 -2 \\
   HClO_2 & \\
   +6 -2 & \\
   MoS_3 & \\
   +2 &+7 -2 & \\
   Mg(ClO_4)_2 & \\
   +1 &+6 -2 & \\
   Cs_2SO_4 & \\
   \end{align*} \]
6. Define acid, base, salt, electrolyte (strong and weak), and nonelectrolyte. See notes or textbook.
7. Identify each of the following reactions as a) an combination, decomposition, single displacement, or double displacement (metathetical) reaction; and b) (for the bottom 2 reactions below) oxidation-reduction (redox) or acid-base reaction.
   \[ \begin{align*}
   C_2H_4 + H_2 & \rightarrow C_2H_6 & \text{combination} \\
   H_3PO_4 + Na_2CO_3 & \rightarrow Na_2HPO_4 + H_2CO_3 & \text{double displacement, acid-base} \\
   4KClO_3 & \rightarrow KCl + 3KClO_4 & \text{decomposition, redox} \\
   \end{align*} \]
8. Write the products and use the activity series in your textbook to determine whether the redox reaction below would occur.
   \[ \text{Al} + 3 \text{NaCl} \rightarrow \text{AlCl}_3 + 3 \text{Na} \]
   Will not occur. Na higher than Al in activity series.
9. Write the products and use the solubility chart in your textbook to determine whether the precipitation reaction below would occur.
   \[ 3 \text{Na}_2S + 2 \text{Al(NO}_3)_3 \rightarrow 6 \text{NaNO}_3 + \text{Al}_2S_3 \]
   \[ \text{Al}_2S_3 \text{ is insoluble. Reaction will occur.} \]
10. Write the net ionic equation for the reaction.
   \[ 2 \text{Al}^{3+} + 3 \text{S}^{2-} \rightarrow \text{Al}_2S_3 \]
11. The pressure of the atmosphere is measured with a barometer. This device uses the height of mercury in a tube.
   \[ \text{Pressure, Temperature, and Volume} \]
12. Give the mathematical expression for each of the following: Some can be expressed in more than one form. I’ve shown three forms for Boyle’s law but only one form for the others. Boyle's law \[ V \propto \frac{1}{P} \] or \[ V = \text{constant} \times \frac{1}{P} \] or \[ V_1P_1 = V_2P_2 \] Charles's law \[ V \propto T \] Gay-Lussac's law \[ P \propto T \],
   Avogadro's law \[ V \propto n \], and Dalton's Law \[ P_{\text{total}} = P_1 + P_2 + \ldots \].
13. Which is denser at room temperature — chlorine gas or argon gas? Chlorine gas (Cl2) has a greater molar mass
   \[ 0.700 \text{ L} \]
14. \( \text{T/F} \) Xe is a monatomic gas. Noble gases like Xe are stable without bonding to another atom.
15. Arrange the following gases in increasing order by pressure: Ar at 7.50 kPa < He at 200.0 torr < Ne at 3.00 atm.
   \[ 1.13 \text{ L} \]
16. The volume of a sample of carbon monoxide, CO, is 1.40 L at 2.25 atm and 467 K. What volume will it occupy at 4.50 atm and 467 K?
   \[ 0.700 \text{ L} \]
17. What is the volume of a sample of ethane, C2H6, at 467 K and 2.25 atm if it occupies 1.405 L at 300.0 K and 2.25 atm?
   \[ 2.19 \text{ L} \]
18. A gas occupies 275 mL at 100.°C and 380.0 kPa. What final temperature is required to decrease the pressure to 305 kPa if the volume is held constant?
   \[ 299 \text{ K} \]
19. A gas occupies a volume of 12.0 L at 685.4 torr and 85.6°C. What would be its volume at 98.7 kPa and 64.8 °C?
   \[ 10.5 \text{ L} \]
20. What volume of O2 at STP is required to oxidize 20.0 L of CO at STP to CO2? What volume of CO2 is produced at STP?
   \[ 2\text{CO} + O_2 \rightarrow 2\text{CO}_2 \]
   \[ 10.0 \text{ L} \text{O}_2 \]
   \[ 20.0 \text{ L} \text{CO}_2 \]
21. What is the molar volume of a gas at 373K and 1.50 atm?
   \[ 20.4 \text{ L} \]
22. How many moles of carbon monoxide, CO, are contained in a 327.2 mL bulb at 48.1°C if the pressure is 149.3 kPa?
   \[ 0.01829 \text{ mol} \]
23. A gas collected over water has a pressure of 753.6 torr for 1.32 L at 30.0°C. (PH2O at 30.0°C = 31.8 torr) What is the volume of dry gas at STP?
   \[ 1.13 \text{ L} \]
24. What is the temperature of a 0.274 g sample of methane, CH4, confined in a 300.0 mL bulb at a pressure of 198.7 kPa?
   \[ 420. \text{ K} \]
25. How many grams of gas are present in 0.100 L of CO2 at 307 torr and 26°C?
   \[ 0.0725 \text{ g} \text{CO}_2 \]
26. Calculate the density of Freon-12, CF2Cl2, at 30.0°C and 0.954 atm.
   \[ 4.64 \text{ g/L} \]
27. What is the molecular mass of a gas with a density of 1.43 g/L at STP?
   \[ 32.1 \text{ g/mol} \]
28. What is the density of bromine vapor at 373K and 1.00 atm?
   \[ 5.22 \text{ g/L} \]
29. What is the molecular mass of an unknown gas if 0.493 g occupies 257 mL at STP?
   \[ 43.0 \text{ g/mol} \]
30. What is the molecular mass of a gas if 125 mL of the gas at a pressure of 99.5 kPa at 22°C has a mass of 0.157 g?
   \[ 31.0 \text{ g/L} \]
31. A sample of an oxide of nitrogen isolated from the exhaust of an automobile was found to weigh 0.571 g and to occupy 1.00 L at 356 torr and 27°C. Calculate the molecular mass and determine if it was N2O, NO, NO2, N2O4, or N2O5
   \[ 30.0 \text{ g/mol}, \text{NO} \]
32. In a common freshman laboratory experiment, KClO₃ is decomposed by heating to give KCl and O₂. What mass of KClO₃ must be decomposed to give 230 mL of O₂ at a temperature of 28°C and a pressure of 752 torr? 0.753 g KClO₃

33. What is the volume of 1 mole of Cl₂ at STP? 22.4 L

34. If hydrogen gas diffuses at 2.5 ft/min, how fast will nitrogen dioxide diffuse? 0.52 ft/min

35. Heavy water, D₂O, (M=20.03) can be separated from ordinary water, H₂O,(M=18.01) as a result of the difference in the relative rates of diffusion of the molecules in the gas phase. Calculate the relative rates of diffusion of H₂O and D₂O. 1.055 to 1

36. (T/F) a) T Pressure in a container of gas results from bombardment of the wall by gas molecules. b) T Gas molecules move in straight lines and change direction when they collide with other molecules or the walls of the container. c) F Collisions are not elastic, energy is lost to friction. d) T At low pressures, distance between gas molecules is large in comparison to their size. e) T At low pressures, attractive forces must be considered. f) F Average kinetic energy for all gases is proportional to the temperature in Celsius.

37. When is it necessary to apply Van der Waals equation, \( P + n^2a/V^2)(V - nb) = nRT \) at low temperature, and/or high pressure.

38. What do the parameters a and b represent in the Van der Waals equation? a) The attraction between molecules and b) the volume of the molecules.

39. Give the most important forces responsible for forming solids of the following: a. Ar dispersion forces b. NH₃ H bonding c. Br₂ dispersion forces d. CH₄ dispersion forces e. BrCl dipole-dipole f. KCl ionic bonding g. NaCl in H₂O ion-dipole

40. Which has the higher boiling point, Cl₂ or I₂? What type of force contributes to this? dispersion forces Explain. The greater number and more loosely held electrons around the bigger iodine lead to larger dispersion forces.

41. Which compound H₂S or H₂O has the higher boiling point? What type of force contributes to this? H bonding

42. Rank the following from the lowest to the highest boiling point. CH₄ nonpolar; C₃H₈ bigger nonpolar; N₂O₅ polar; NH₃ hydrogen bonding; HF more polar H bonding; K₂SO₄ ionic bonding; Al₂O₃ ionic bonding (higher charges)

43. Rank the following in order of increasing melting point. N₂, HBr, HF, NaCl

44. Above the critical temperature a gas can not be liquefied.

45. Melting point and freezing point are the same temperature.

46. What is vapor pressure? The pressure of vapor in equilibrium with its liquid state. The pressure of a vapor evaporating from the liquid state.

47. What is boiling? The especially rapid evaporation that occurs when the vapor pressure of a liquid equals the surrounding pressure.

48. T (T/F) When the rate of condensation becomes equal to the rate of evaporation, the vapor in the container is in equilibrium with the solid or liquid.

49. T (T/F) Food cooks faster here than in Denver (Mile High City). Higher altitude/lower pressure. Lower pressure/lower boiling point (demo in class). Lower b.p./lower cooking temp (our food contains water so you cannot get it hotter than the b.p. of water). Lower temperature/longer cook time.

50. If the critical pressure of O₂ is 49.7 atm and the critical temperature is 154.3 K, can a sample of O₂ at 140 K be liquefied at a pressure of 100 atm? Yes. 140K is less than the critical temperature. At that temperature a pressure less than the critical pressure is required to liquify O₂.

51. Could a sample of O₂ at 160 K be liquefied at a pressure of 100 atm? No. Above the critical temperature no amount of pressure will condense a substance.

52. The vapor pressure of a liquid generally increases with increasing temperature. We typically boil a substance by warming it until its vapor pressure rises to one atm (at its boiling point). See Figure 12.6, page 432.

53. F (T/F) NaF probably has a higher lattice energy than Na₂O.

54. Answer the following using the diagram at right.

At approximately what temperature will the compound melt at P=20? ~15°
At approximately what pressure will the compound boil if T=40? ~27°
Label gas, liquid, solid, and triple point on the diagram.