

Solve the following problems. Be sure to show all work and to use correct significant figures and units. No credit will be given for answers without supporting work.

1. When 45.67 ml of 0.123 M ammonium sulfate are mixed with 2.887×10^{22} mc of silver nitrate, how many grams of silver sulfate are formed?
2. How many grams of nitrogen will fit in a 350.0 mL container at 67.9°C and 355.5 Torr?
3. Acetic acid normally freezes at 16.6°C . When 13.9 g of sodium chloride are added to 259.9 g of acetic acid, what will the new freezing point be? (k_f of acetic acid = 3.90°C/molal)
4. A 213.98 g piece of copper is dropped into 1000.0 g of water at 45.6°C . If the water cools down to 42.9°C , what must the initial temperature of the copper have been?
5. Use bond energies to calculate the heat of the reaction below.
$$\text{CO}_2 + 2 \text{F}_2 \rightarrow \text{CF}_4 + \text{O}_2$$
6. The K_{sp} of aluminum hydroxide is 3.7×10^{-18} . What is the pH of a saturated solution?
7. The equilibrium constant for the reaction $2 \text{OCl}_2 \rightarrow \text{O}_2 + 2 \text{Cl}_2$ is 4.1×10^{-17} . If you start with 3.11 M OCl_2 , 1.88 M O_2 and no Cl_2 , what will the concentrations be when you reach equilibrium?

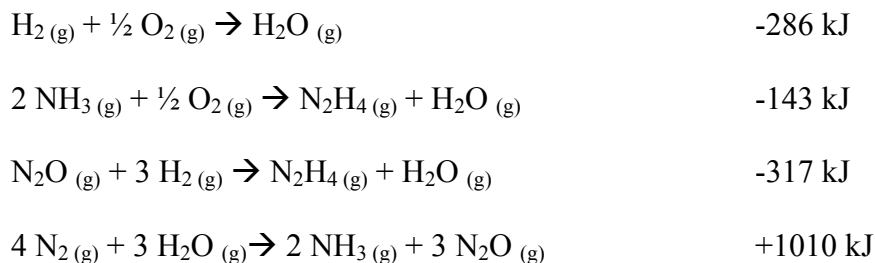
Answer all of the following questions. Complete answers are not required, but complete thoughts are.

8. How does a vacuum cleaner work?
9. Why does putting salt on a slug cause it to shrivel?
10. Why are exothermic reactions usually spontaneous? Be sure to explain what spontaneous means in your answer.
11. Gas molecules take up space, but we pretend that they don't. How can we get away with that?
12. What does increasing the temperature of reaction do to the rate and why?
13. Describe the process by which table salt (sodium chloride) dissolves in water and explain why crushing the salt first speeds up the process.
14. When ammonium iodide is placed in water, will the solution be acidic, basic or neutral. Use reactions to help answer.

Solve the following problems. Be sure to show all work and to use correct significant figures and units. No credit will be given for answers without supporting work.

- When 45.67 ml of 0.123 M aluminum sulfate are mixed with 38.17 grams of barium nitrate, how many molecules of barium sulfate are formed?
- A vendor at the county fair places 3.91 moles of helium in 4.91 liter balloon at 1.034 atmospheres. If the balloon escapes and rises to a height where the pressure is only 543.2 mm Hg and the 1.61 moles of the gas leak out of the balloon, what will the volume of the balloon be?
- Chloroform normally freezes at -63.5°C . When 13.9 g of sodium chloride are added to 259.9 g of chloroform, what will the new freezing point be? (k_f of chloroform = $4.68^{\circ}\text{C/molal}$)
- A 213.98 g piece of copper is dropped into 100.0 g of ice at 0.00°C . If the ice melts and warms up to 18.1°C , what must the initial temperature of the copper have been? ($c_{\text{Cu}}=0.0920$ cal/g $^{\circ}\text{C}$, ΔH_{fus} of ice = 80 cal/g)

19. Determine the ΔH_{rxn} for the reaction $\text{N}_2\text{H}_4(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g})$ from the following:



- The K_{sp} of aluminum hydroxide is 3.7×10^{-18} . What is the pH of a saturated solution?
- The equilibrium constant for the reaction $2 \text{OCl}_2 \rightarrow \text{O}_2 + 2 \text{Cl}_2$ is 4.1×10^{17} . If you start with 3.11 M O_2 , 1.88 M Cl_2 and no OCl_2 , what will the concentrations be when you reach equilibrium?

Answer all of the following questions. Complete answers are not required, but complete thoughts are.

- How does a suction cup work?
- Why do your fingers get all pruny when you take a long bath?
- Methane (the stuff we use in the Bunsen burners in chem. lab) burns spontaneously, yet it doesn't burst into flames when we turn the gas on. Why not? Make sure you ALSO tell me what spontaneous means.
- Gas molecules attract each other, but we pretend that they don't. How can we get away with that?
- What does increasing the temperature of a liquid do to the rate of evaporation and why?
- When a pin is floated on water and a drop of soap is added, the pin moves away from the spot where the soap was added. Why? Be sure to explain how the pin is floating in the first place..
- When lithium nitrate is placed in water, will the solution be acidic, basic or neutral. Use reactions to help answer.

Solve the following problems. Be sure to show all work and to use correct significant figures and units. No credit will be given for answers without supporting work.

29. When 45.67 ml of 0.123 M ammonium sulfate are mixed with 2.887×10^{22} mc of aluminum hydroxide, how many grams of aluminum sulfate are formed?
30. If oxygen takes 58.9 seconds to cross a 34.4 meter room, how long will it take hydrogen to travel 134 cm?
31. Acetic acid normally boils at 118.1°C . When 37.9 g of sodium sulfate are added to 259.9 g of acetic acid, what will the new boiling point be? (k_b of acetic acid = 3.07°C/molal)
32. A 213.98 g piece of copper is dropped into container holding 100.0 g of steam at 100.0°C . If the steam ends up as water at 42.9°C , what must the initial temperature of the copper have been? ($c_{\text{Cu}} = 0.0920 \text{ cal/g } ^\circ\text{C}$, ΔH_{vap} of water = 539 cal/g)
33. Calculate the entropy change (ΔS) of the reaction below using your thermo tables.
$$4 \text{CO}_2 (\text{g}) + 5 \text{H}_2 (\text{g}) + \text{Cl}_2 (\text{g}) \rightarrow 2 \text{C}_2\text{H}_5\text{Cl} (\text{l}) + 4 \text{O}_2 (\text{g})$$
34. The K_{sp} of aluminum hydroxide is 3.7×10^{-18} . What is the $[\text{H}_3\text{O}^+]$ in a saturated solution?
35. The equilibrium constant for the reaction $2 \text{OCl}_2 \rightarrow \text{O}_2 + 2 \text{Cl}_2$ is 4.1×10^{-17} . If you start with 3.11 M OCl_2 , 1.88 M O_2 and no Cl_2 , what will the concentrations be when you reach equilibrium?

Answer all of the following questions. Complete answers are not required, but complete thoughts are.

36. Why is it a bad idea to throw a can of spray paint in the fire? Be sure that your answer uses appropriate chemistry.
37. What happens to a slug if you drop it in distilled or deionized water and why?
38. A friend says, "All exothermic reactions are spontaneous. Just look at the melting of ice." Explain why each incorrect part of the statement is incorrect and fix it.
39. Under what conditions do we need to care about the attraction between gas molecules and what is it about those conditions that makes us care?
40. What happens to the equilibrium below if extra CaCO_3 is added and why?
$$2 \text{HCl} (\text{aq}) + \text{CaCO}_3 (\text{s}) \rightarrow \text{CaCl}_2 (\text{aq}) + \text{H}_2\text{CO}_3 (\text{aq})$$
41. There are two reasons that stirring increases the rate of solvation (dissolving). What are they and why do they increase the rate?
42. When barium oxalate is placed in water, will the solution be acidic, basic or neutral. Use reactions to help answer.

Solve the following problems. Be sure to show all work and to use correct significant figures and units. No credit will be given for answers without supporting work.

43. When 475.67 ml of 2.123 M oxalic acid are mixed with 388.17 grams of sodium sulfite, how many molecules of sodium oxalate are formed?
44. If it takes chlorine gas 1245 seconds to go 469.1 m, how long will it take oxygen to go 4.67 km?
45. Ethyl alcohol normally freezes at -114.6°C . When 13.9 g of strontium chloride are added to 259.9 g of ethyl alcohol, what will the new freezing point be? (k_f of ethyl alcohol = $1.99^{\circ}\text{C/molal}$)
46. A 213.98 g piece of copper is dropped into 100.0 g of steam at 100.0°C . If the steam condenses and cools to 18.1°C , what must the initial temperature of the copper have been? ($c_{\text{Cu}}=0.0920 \text{ cal/g } ^{\circ}\text{C}$, ΔH_{vap} of steam = 539 cal/g)
47. Calculate the entropy change (ΔS) of the reaction below using your thermo tables.
 $4 \text{ CO}_2 (\text{g}) + 5 \text{ H}_2 (\text{g}) + \text{Cl}_2 (\text{g}) \rightarrow 2 \text{ C}_2\text{H}_5\text{Cl} (\text{l}) + 4 \text{ O}_2 (\text{g})$
48. The K_{sp} of aluminum hydroxide is 3.7×10^{-18} . What is the $[\text{H}_3\text{O}^+]$ in a saturated solution?
49. The equilibrium constant for the reaction $2 \text{ OCl}_2 \rightarrow \text{O}_2 + 2 \text{ Cl}_2$ is 4.1×10^{17} . If you start with 3.11 M O_2 , 1.88 M Cl_2 and no OCl_2 , what will the concentrations be when you reach equilibrium?

Answer all of the following questions. Complete answers are not required, but complete thoughts are.

50. Hot air balloons are not blown up, they heated, but they get bigger anyway. How does that work?
51. Bath water makes your skin swell, but sea water dries your skin. Why?
52. The decomposition of many solids results in gases (for example $2 \text{ KClO}_3 \rightarrow 2 \text{ KCl} (\text{s}) + 3 \text{ O}_2 (\text{g})$). Does entropy go up or down and how do you know? As a result, would you expect decompositions to be spontaneous, non-spontaneous, or sometimes spontaneous?
53. Gas molecule collisions are not really elastic, but we pretend they are. How can we get away with that?
54. When a sample of solid _____ is placed under immense pressure, the solid will _____. There are two possible answers to this question. If the first blank is filled in with water, what is the second answer and why does it happen?
55. What happens when a drop of oil is placed in water and why? What happens when a drop of water is placed in oil and why?
56. When scandium bromide is placed in water, will the solution be acidic, basic or neutral. Use reactions to help answer.