Practice for Solutions and Water - ANSWERS

1. How many grams of ammonia (NH_3) saturate a 100 mL solution at 90°C? Look at table G, it's 10 grams.

2. How many grams of ammonia (NH_3) saturate a 575 mL solution at 90°C?

90°C $\frac{NH_3}{\text{Water}}$ $\frac{10\text{ g}}{100\text{ mL}}$ $\frac{X\text{ g}}{575\text{ mL}}$ 100 X = 5750 X = 57.5 grams

3. If you start with a 100 mL saturated solution of $KClO_3$ at 100°C and cool it rapidly to 25°C, how many grams of solute fall out as a precipitate?
At 100°C this solution can hold 60 grams of potassium chlorate. If you cool it down to 25°C it can only hold 10 grams.
So, 60 grams - 10 grams = 50 grams of precipitate

4. If you start with a 364 mL saturated solution of $KClO_3$ at 100°C, cool it rapidly to 25°C, how many grams precipitate?

100°C $\frac{KClO_3}{\text{Water}}$ $\frac{60\text{ g}}{100\text{ mL}}$ $\frac{X\text{ g}}{364\text{ mL}}$ 100 X = 21840 X = 218 g will fit in this solution

25°C $\frac{KClO_3}{\text{Water}}$ $\frac{10\text{ g}}{100\text{ mL}}$ $\frac{X\text{ g}}{364\text{ mL}}$ 100 X = 3640 X = 36.4 g will fit in this solution.

That means that starting with 218 g - 36.4 g = 181.6 = 182 grams will precipitate out (with 3 SF)

5. Explain the dynamic equilibrium that occurs in question 4.
At the bottom of the beaker will be a pile (182 g) of solid potassium chlorate, but it will continue to dissolve into the water, but at the same time, and importantly: AT THE SAME RATE, it will precipitate out of solution. There will be a steady amount on the bottom (182 g) and a steady amount dissolved (36.4 g), but they will keep changing places with each other at a constant rate.

6. A 100 mL saturated solution of sodium acetate contains approximately 169 grams at 100°C. If you create a 20°C saturated solution of sodium acetate it is saturated with just 123 grams of sodium acetate. If you start with the hot solution, and cool it, all 169 grams remain aqueous at 20°C, how is this possible?
Some compounds, this being one of them, can "supersaturate". That means when you start hot, and can dissolve more solute into a hot water solution, and gently cool it down, this compound can "trick" the water into keeping all of the solute dissolved. You can't mix it up cold, but if you start hot, then cool down, with a few compounds the solution ends up holding more solute than would be possible if you started out with colder water.

7. Tell what "when bonds form, energy is released" means. Refer to ionic bonds and also to hydrogen bonds in your explanation.
In chemistry, whenever a bond forms, it's more stable. So when bonds form, they release energy as they become more stable. If ionic bonds form, as with the reusable heat pads, they release energy. If steam condenses onto your finger, the gas H_2O condenses into the liquid phase. That is possible because as the hydrogen bonds between the molecules start to hold the molecules together as a liquid, when these bonds form, energy is released. When ANY bonds form, energy is released. It's exothermic.

8. What is the molarity of a sodium nitrate solution that contains 34.8 grams in 425 mL of solution?

M = $\frac{\#\text{ moles}}{\text{Liters}}$ $\frac{0.409\text{ moles}}{0.425\text{ L}}$ 0.962 M (the number of moles comes from 34.8 g X 1 mole/85 grams = 0.409 moles)

9. If you have a 2.25 M $NaCl_{(AQ)}$ of 1550 mL, how many grams of NaCl are present?

M = $\frac{\#\text{ moles}}{\text{Liters}}$ 2.25 M = $\frac{\#\text{ moles}}{1.55\text{ L}}$ # moles = 3.49 moles NaCl → 3.49 moles X 58 g/mole = 202 grams NaCl (3 SF)

10. If a solution is 3.50 M and contains 671 grams of HCl, what volume is this solution?

$M = \frac{\text{\# moles}}{\text{Liters}}$ $\quad 3.50\ M = \frac{18.6 \text{ moles}}{X \text{ Liters}}$ $\quad 3.50\ X = 18.6$ $\quad X = 5.31$ Liters

11. If your stock solution is 8.65 M NaOH, how would you mix up a solution of 3.45 M and 225 mL $NaOH_{(AQ)}$?
$M_1V_1 = M_2V_2$ $\quad (8.65\ M)(V_1) = (3.45\ M)(225\ mL)$ $\quad V_1 = 88.7$ mL stock.

Put the 84.5 mL stock into a flask, fill the flask with water up to the 225 mL mark (approximately: 225mL - 88.7mL = water needed)

12. What is the boiling point of a 3.75 M $KCl_{(AQ)}$ solution of 1L volume? 373 K + (3.75 X 2 x 0.50 K) = 373 + 3.75 = 376.75 K (no SF)
13. Skip this one
14. What is the freezing point of a 3.75 M $KCl_{(AQ)}$ solution of 1 L volume? 273 K -(3.75 X 2 X 1.86 K) = 273 - 13.95 = 259.05 K (no SF)
15. Why does this KCl solution conduct electricity? Any solution with LOOSE ions conducts electricity. All ionic compounds that are aqueous will not only dissolve to invisibly small particles, those particles are ions.
16. Does solid KCl conduct electricity? If not, why not. If yes, how? KCl solid does not have loose ions, it cannot conduct electricity. It would still be an electrolyte though, because IF you put it into water, it would ionize and conduct electricity.
17. Does MELTED, or molten KCl conduct electricity? YES, molten means melted, which means loose ions. It would be crazy hot, but it would conduct electricity.
18. Can you make up a 50.0 mL 5.00 M KCl using this 3.75 M $KCl_{(AQ)}$ solution? How, or why not? No, you can only make solutions that are more dilute, not more concentrated in our high school course.
19. Which cup would evaporate faster in a room, a 400. mL cup of pure water or a 400. mL cup of 1.00 M $NaCl_{(AQ)}$? Water does not like to evaporate, but salty water evaporates even slower. The water is attracted to itself, and to the loose ions as well.
20. What does “like dissolves like” mean? Water is polar, name two molecular compounds that would dissolve into water, and two more that would not dissolve into water.
Water is polar, it dissolves polar molecules, and many ionic compounds. Polar molecules that dissolve into water include HCl, NH_3, PCl_3, CH_3Br, and CH_3OH. Molecules that are nonpolar will not dissolve into water, including CH_4, CCl_4, N_2.
21. If a hot tub of 425 liters has a level of 7.50 PPM of sugar , how many grams of sugar are in this tub?

$PPM = \frac{\text{Grams solute}}{\text{Grams solution}} \times 1{,}000{,}000 =$ $\quad 7.50\ PPM = \frac{X\ g}{425{,}000\ g} \times 1{,}000{,}000$

$7.50\ PPM = \frac{X\ g}{425\ g} \times 1{,}000$ $\quad 7.50\ PPM = 2.35\ X$ $\quad X = 3.19$ g sugar

22. Draw six water molecules that surround these 2 ions that are floating in an aqueous solution. Make sure that the water molecules “orient” properly.