Solutions and Solubility Review

NOTE: Use any Solubility Table and a Solubility Curve Graph to complete relevant questions.

See our current unit plan for which questions you do and do not need to do this semester.

1. Explain how an ionic substance like KCl dissolves in water.

2. As temperature increases, the solubility of $NaNO_3$ in water increases and the solubility of oxygen decreases. Give reasons for these different solubility trends.

3. Explain the difference between dilute and concentrated solutions.

4. Give an example of a solution with a gas dissolved in a gas.

5. Using the solubility table below, state whether the following ionic compounds are soluble or insoluble in water.

Compound	Soluble or insoluble
(a) PbI_2	
(b) $KClO_3$	
(c) $CaCO_3$	
(d) $BaSO_4$	

6. Differentiate between the terms saturated, unsaturated, and supersaturated.

7. State the level of saturation of a solution at the following points on a typical solubility curve:

    (a) point above the curve
    (b) point below the curve
    (c) point directly on the curve

8. A sample of well water is known to contain a high concentration of iron. What solution could you use to test the water to get a positive precipitate test for the dissolved iron?

9. Consider the following reaction: Barium chloride solution is mixed with potassium sulphate solution to produce a solid precipitate barium sulphate and a solution of potassium chloride.

    For this reaction, write

    (a) a balanced chemical equation
    (b) a total ionic equation
    (c) a net ionic equation

10. Consider the following reaction: aqueous nickel(II) nitrate reacts with aqueous sodium sulphite.

    For this reaction, write

    (a) a balanced chemical equation
    (b) a total ionic equation
    (c) a net ionic equation

11. Use the solubility curves to explain which ionic compound, potassium chlorate or potassium nitrate, has greater solubility in water.

12. A chemist mixes aqueous potassium iodide with lead(II) acetate to produce a bright yellow precipitate for her chemistry magic show. Write the net ionic equation for this reaction.

13. Write the ionic equation to represent the dissociation of calcium hydroxide.
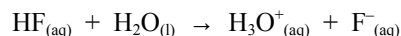
14. What is the concentration of hydrogen ions in

(a) acidic solutions
(b) basic solutions

15. According to the revised Arrhenius theory, define an acid and a base.

16. Define acid and base according to the Bronsted-Lowry theory.

17. Identify the two acid-base conjugate pairs in the following reaction:

$$HF_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + F^-_{(aq)}$$

18. Write a balanced chemical equation for the neutralization of aqueous perchloric acid by aqueous barium hydroxide.

19. T.S.P. is an all purpose cleaner that can be used to clean driveways. What volume of solution would you get if you dissolved 150.0 g of sodium phosphate with water to produce a 0.23 mol/L solution?

20. Concrete etch solution can be used to clean concrete before painting it. The directions tell you to dissolve 680 g of sodium bisulphate in 3.4 L of water. What is the concentration of this solution in g/100 mL?

21. How much water must be added to 600 mL of a 1.5 mol/L $CaCl_2$ solution to make the concentration of the resulting solution 1.0 mol/L?

22. One brand of mineral water contains 1.55 ppm of dissolved nitrate. Calculate the mass of nitrate in an 11.0-L container of this bottled water.

23. Some commercial bleach solutions contain 5.25% W/V sodium hypochlorite. Calculate the sodium hypochlorite concentration in mol/L.

24. Refer to the solubility curves of various ionic compounds in water.

    (a) What mass of KCl can be dissolved in 100 mL of water at 60ºC?
    (b) What mass of KCl can be dissolved in 2.5 L of water at 30ºC?

25. A saturated solution of $KClO_3$ is cooled from 50ºC to 5ºC when it is placed into a fridge. Calculate how much potassium chlorate will crystallize from a 1.0-L solution.

26. Students in a chemistry lab are making the compound cobalt(II) carbonate. It can be made by reacting sodium carbonate solution with cobalt(II) chloride solution. Calculate the volume of 1.0 mol/L cobalt(II) chloride solution required to completely react with 250 mL of 1.5 mol/L sodium carbonate.

27. 100 mL of 0.2 mol/L sodium carbonate solution and 200 mL of 0.1 mol/L calcium nitrate solution are mixed together. Calculate the mass of calcium carbonate that would precipitate and the concentration of the sodium nitrate solution that will be produced.

28. A student wishes to precipitate all of the silver ions from 3.0 L of a 0.85 mol/L $AgNO_3$ solution. If the student is aiming to precipitate silver chloride, suggest and calculate an appropriate solute, concentration, and volume for a reacting solution.

29. 500 g of copper metal is reacted with 2.5 L of 3.0 mol/L nitric acid solution. Calculate how much of the copper metal remains after the reaction is complete.

30. A student mixed 100.0 mL of a 0.100 mol/L solution of barium chloride with 100.0 mL of a 0.100 mol/L solution of iron(III) sulphate. The barium sulphate precipitate was filtered, dried, and was measured to have a mass of 2.0 g. Calculate the % yield of the barium sulphate.

31. A 750 mL saturated solution of potassium sulphate has been prepared in the lab at a temperature of 20ºC. How much more potassium sulphate could be dissolved in this solution if it is heated to 70ºC?

32. Assume that the solubility of carbon dioxide gas in pop at 5ºC is 0.586 g/100 mL (supersaturated) and at 20ºC its solubility is 0.169 g/100 mL. What mass of carbon dioxide gas will escape from a 355-mL can of Coke that has been taken out of the fridg (5ºC) and has been sitting open at 20ºC?

33. Barium sulphate has a low solubility in water and is commonly used as a suspension in hospitals to be taken internally for abdominal X-rays. The solubility of barium sulphate at 20ºC is 0.25 mg/100 mL of water. If 1.5 g of barium sulphate is placed into 2.0 L of water, calculate the mass of precipitate that would settle to the bottom after a tiny amount dissolves at 20ºC?

34. The maximum quantity of oxygen that dissolves in water at 0ºC is 14.7 ppm and at 25ºC it is 8.7 ppm. Calculate the difference in the mass of oxygen that can be dissolved in 75 L of water at the two temperatures.

35. A swimming pool has a pH of 7.5. Calculate the hydrogen ion concentration in the pool.

36. A quality-control technician is testing the concentration of muriatic acid (hydrochloric acid) to check that the concentration is within certain limits. Calculate the concentration of the hydrochloric acid if a 15.0-mL sample (diluted by factor of 10) is titrated with standard sodium carbonate solution. The titration required 10.00 mL of 0.250 mol/L sodium carbonate to neutralize the acid.

37. Cameco in Port Hope, Ontario uses hydrofluoric acid to make an uranium hexafluoride product which is used a fuel for nuclear reactors. A waste drum containing 85.0 L of 6.0 mol/L hydrofluoric acid needs to be neutralized so that it isn't hazardous. Calculate the mass of potassium hydroxide pellets that would be required to completely neutralize the acid.

38. A teaspoon of milk of magnesia contains 12.0 mg of magnesium hydroxide. What volume of 0.01 mol/L HCl in a person's stomach would be neutralized by this teaspoon of antacid?