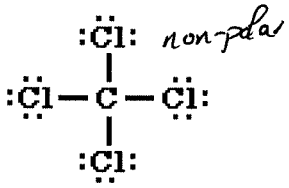
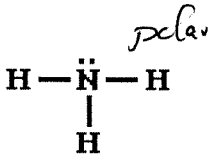
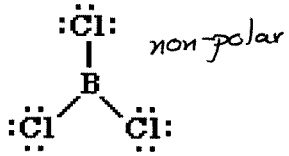
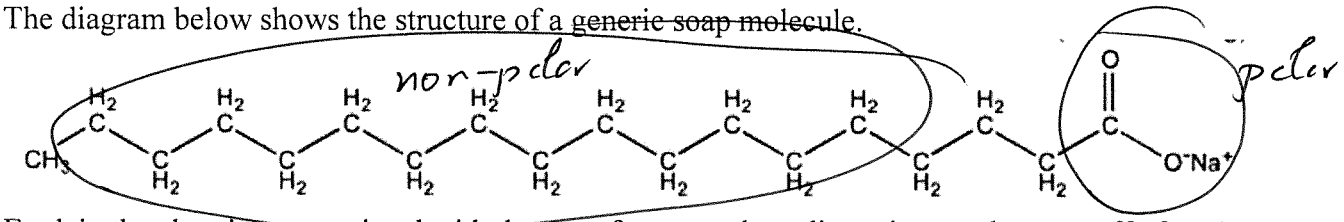
Solutions Quiz 45 Pts

1. Water (H_2O) and hexane (C_6H_{14}) are common solvents. Based on polarity/non-polarity considerations, identify whether the following substances would dissolve in water or in hexane.

Carbon tetrachloride - CCl_4	Ammonia - NH_3	Boron trichloride - BCl_3
 non-polar	 polar	 non-polar
Dissolves in … H_2O C_6H_{14}	Dissolves in … H_2O C_6H_{14}	Dissolves in … H_2O C_6H_{14}
(circle one)	(circle one)	(circle one)

6

2. The diagram below shows the structure of a ~~generic soap molecule~~.



Explain the chemistry ~~associated with~~ the use of soap to clean dirt, grime, and grease off of one's hands. That is, how does soap work as an effective cleaner? (Talk NERDY to me! And use the chemistry learned in this unit.)

A soap molecule has a polar and a non-polar end. The non-polar end has C-H bonds and C-C bonds. This end attracts to non-polar dirt, grime & grease molecules. The opposite end of the soap molecule has polar and ionic bonds. It attracts to H_2O molecules. Thus soap is able to make two otherwise non-attracted species — H_2O and dirt/grime/grease — adhere to each other

5

3. Write the balanced equation for the dissociation of iron(II) nitrate in water. Show ion charges and state symbols.

4

$$Fe(NO_3)_{2(s)} \longrightarrow Fe^{2+}_{(aq)} + 2\,NO_3^-{}_{(aq)}$$

15

4. Determine the molarity of an aqueous solution of NaOH if 2.85 grams of the solute are dissolved in 250.0 mL of water. **PSYW**

$$2.85\,g\ NaOH \times \frac{1\ mol\ NaOH}{39.997\,g\ NaOH} = 0.071255...\ mol\ NaOH$$

4

$$[NaOH] = \frac{0.071255...\ mol}{0.250\ L} = \boxed{0.285\,M}$$

5. What mass of sodium nitrate must be added to 500.00 mL of water in order to prepare a 0.150 M aqueous solution? **PSYW**

$$0.50000\ L\ soln \times \frac{0.150\ mol\ NaNO_3}{1\ L\ soln} \times \frac{84.9947\,g\ NaNO_3}{1\ mol\ NaNO_3} = \boxed{6.37\,g\ NaNO_3}$$

4

6. A chemist mixes 150.0 mL of 0.200 M potassium chloride, 250.0 mL of 0.200 M magnesium chloride, and 300.0 mL of 0.250 M aluminum chloride. What is the molarity of chloride ion in the final solution?

8

$$KCl: 0.150\ L \times \frac{0.200\ mol\ Cl^-}{1\ L\ soln} = 0.0300\ mol\ Cl^-$$

2 Cl^- in Formula

$$MgCl_2: 0.250\ L \times \frac{0.400\ mol\ Cl^-}{1\ L\ soln} = 0.100\ mol\ Cl^-$$

3 Cl^- in Formula

$$AlCl_3: 0.300\ L \times \frac{0.750\ mol\ Cl^-}{1\ L\ soln} = 0.225\ mol\ Cl^-$$

$$0.0300 + 0.100 + 0.225 = 0.355\ mol\ Cl^-$$

$$[Cl^-] = \frac{(0.03 + 0.10 + 0.225)\ mol}{(0.150 + 0.250 + 0.300)\ L} = \boxed{0.507\,M}$$

16

7. Consider the precipitation reaction of $CuCl_2$ with NaOH.

$$Cu^{2+}_{(aq)} + 2\ OH^-_{(aq)} \rightarrow Cu(OH)_{2\,(s)}$$

Suppose 200.0 mL of 0.350 M $CuCl_2$ are combined with 450.0 mL of 0.200 M NaOH. Determine the number of moles of each ion and determine the limiting reactant.

6 moles Cu^{2+} = 0.0700 mol (0.200 * 0.350) moles OH^- = 0.0900 mol (0.450 * 0.200 ×2) limiting rxt = OH^- (or NaOH)

Finally, determine the mass of $Cu(OH)_2$ that are precipitated from this reation. **PSYW**

2 $0.0900\ mol\ OH^- * \frac{1\ mol\ Cu(OH)_2}{2\ mol\ OH^-} * \frac{97.561\ g\ Cu(OH)_2}{1\ mol\ Cu(OH)_2} = \boxed{4.39\ g\ Cu(OH)_2}$

For **Questions #8 - #10:** Use the solubility curve at the right to answer the following questions.

8. Which one of the following has the greatest solubility at 20°C?

2 a. NH_3 b. KNO_3
(c.) $NaNO_3$ d. NH_4Cl

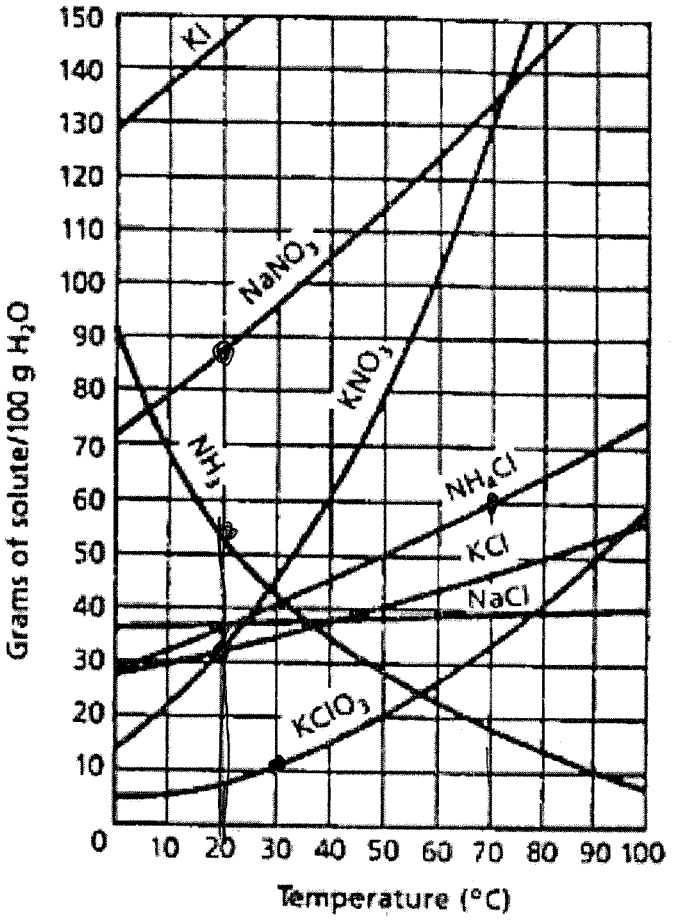
9. How many grams of ammonium chloride (NH_4Cl) can dissolve in 100 g of water at 70°C?

2 a. 29 (b.) 60
c. 75 d. 90

10. A beaker contains 50 grams of water. How much $KClO_3$ can be dissolved in this water at 30°C?

(a.) 5.5 b. 11
2 c. 15 d. 30
e. 60

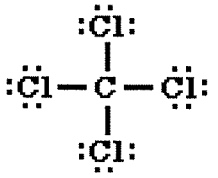
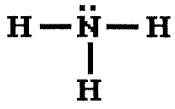
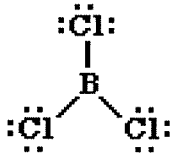
11 g $KClO_3$ / 100 g H_2O



14

Solutions Quiz 45 Pts

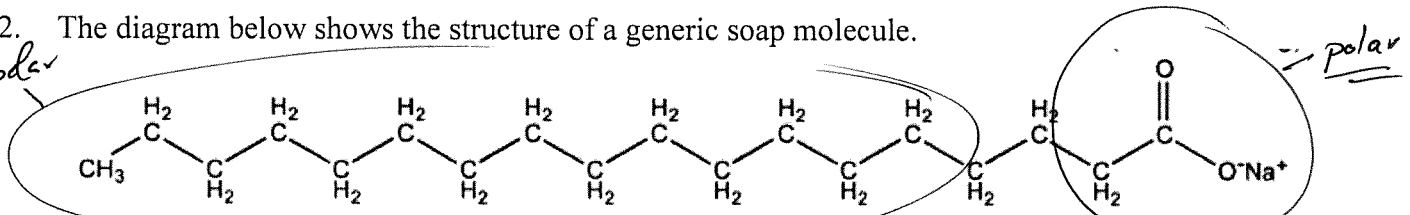
1. Water (H_2O) and hexane (C_6H_{14}) are common solvents. Based on polarity/non-polarity considerations, identify whether the following substances would dissolve in water or in hexane.

Carbon tetrachloride - CCl_4	Ammonia - NH_3	Boron trichloride - BCl_3
		
Dissolves in … H_2O C_6H_{14} (circle one)	Dissolves in … H_2O C_6H_{14} (circle one)	Dissolves in … H_2O C_6H_{14} (circle one)

6

2. The diagram below shows the structure of a generic soap molecule.

non-polar



polar

Explain the ~~chemistry associated with the use of soap to~~ clean dirt, grime, and grease ~~off of~~ one's hands. That is, how does soap work as an effective cleaner? (Talk NERDY to me! And use the chemistry learned in this unit.)

A soap molecule has a polar and a non-polar end. The non-polar end has C-C and C-H bonds. This end attracts to non-polar dirt, grime, and grease molecules. The opposite end of the soap molecule has polar covalent and ionic bonds. It attracts to H_2O molecules. Thus, soap is able to make two otherwise non-attractable species — H_2O and dirt/grease/grime — associate with each other. By so doing, water can clean dirt/grease/grime thru the help of soap

5

3. Write the balanced equation for the dissociation of copper(II) nitrate in water. Show ion charges and state symbols.

$$Cu(NO_3)_{2(s)} \longrightarrow Cu^{2+}_{(aq)} + 2\,NO_3^-{}_{(aq)}$$

4

15

4. Determine the molarity of an aqueous solution of NaOH if 4.21 grams of the solute are dissolved in 450.0 mL of water. **PSYW**

$$4.21\text{ g NaOH} \times \frac{1\text{ mol NaOH}}{39.997\text{ g NaOH}} = 0.105257\ldots\text{ mol NaOH}$$

4

$$[NaOH] = \frac{0.105257\ldots\text{ mol}}{0.450\text{ L}} = \boxed{0.234\text{ M}}$$

5. What mass of sodium nitrate must be added to 400.00 mL of water in order to prepare a 0.125 M aqueous solution? **PSYW**

$$0.400000\text{ L soln} \times \frac{0.125\text{ mol NaNO}_3}{1\text{ L soln}} \times \frac{84.9947\text{ g NaNO}_3}{1\text{ mol NaNO}_3} = \boxed{4.25\text{ g NaNO}_3}$$

4

6. A chemist mixes 250.0 mL of 0.200 M potassium chloride, 200.0 mL of 0.250 M magnesium chloride, and 350.0 mL of 0.150 M aluminum chloride. What is the molarity of chloride ion in the final solution?

8

KCl: $0.2500\text{ L} \times \frac{0.200\text{ mol}}{1\text{ L soln}} = 0.0500\text{ mol}$

2 Cl^- ion/formula

$MgCl_2$: $0.2000\text{ L} \times \frac{0.500\text{ mol}}{1\text{ L}} = 0.1000\text{ mol}$

3 Cl^- ion/formula

$AlCl_3$: $0.3500\text{ L} \times \frac{0.450\text{ mol}}{1\text{ L}} = 0.1575\text{ mol}$

0.3075

~~0.2025~~ mol Cl^-

$$[Cl^-] = \frac{0.3075\text{ mol } Cl^-}{0.800\text{ L}} = \boxed{0.384\text{ M}}$$

7. Consider the precipitation reaction of $CuCl_2$ with NaOH.

$0.250L \times \frac{0.300\ mol}{1L}$ $\qquad Cu^{2+}_{(aq)} + 2\ OH^-_{(aq)} \rightarrow Cu(OH)_{2\,(s)}$ $\qquad 0.500L \times \frac{0.200\ mol}{1L}$

Suppose 250.0 mL of 0.300 M $CuCl_2$ are combined with 500.0 mL of 0.200 M NaOH. Determine the ~~number of~~ moles of each ion and determine the limiting reactant.

6 moles Cu^{2+} = 0.075 mol moles OH^- = 0.100 mol limiting rxt = OH^- or NaOH

Finally, determine the mass of $Cu(OH)_2$ that are precipitated from this reaction. **PSYW**

2 $0.100\ mol\ OH^- \times \frac{1\ mol\ Cu(OH)_2}{2\ mol\ OH} \times \frac{97.561g\ Cu(OH)_2}{1\ mol\ Cu(OH)_2} = 4.88g\ Cu(OH)_2$

For **Questions #8 - #10:** Use the solubility curve at the right to answer the following questions.

8. How many grams of ammonium chloride (NH_4Cl) can dissolve in 100 g of water at 70°C?

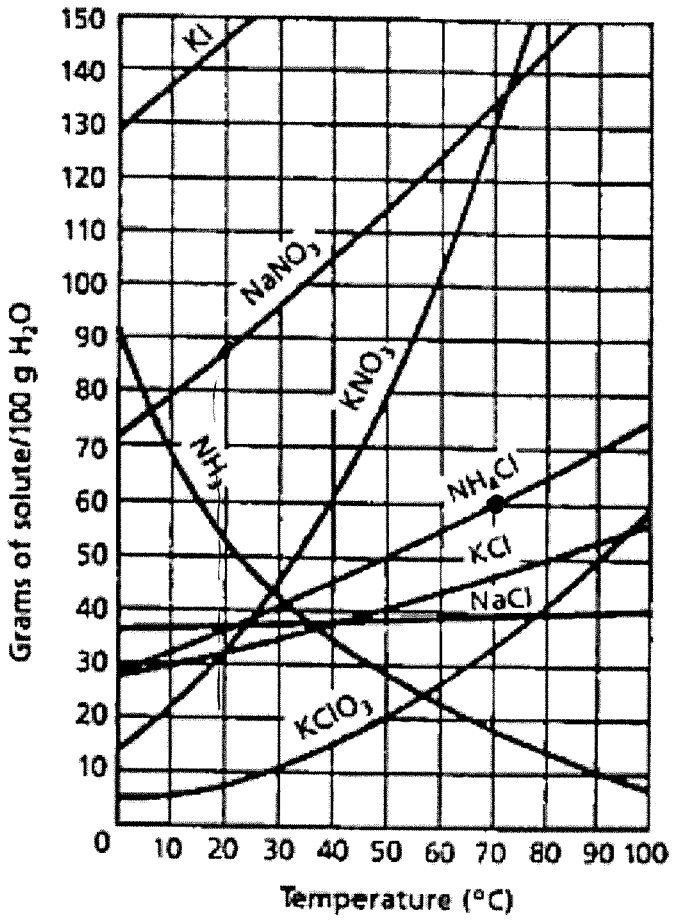
2
a. 29 b. 60
c. 75 d. 90

9. Which one of the following has the greatest solubility at 20°C?

a. NH_3 b. KNO_3
2 c. $NaNO_3$ d. NH_4Cl

10. A beaker contains 50 grams of water. How much $KClO_3$ can be dissolved in this water at 30°C?

2
a. 5.5 b. 11
c. 15 d. 30
e. 60



14