Name Answer key (Sturman)

CHEMISTRY

SECOND SEMESTER REVIEW PROBLEMS & QUESTIONS

CHAPTER 11 REACTION TYPES

1. Complete the following reactions and balance them.

Reactants → Products

$Ca_{(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_{2(g)}$

a. Which are the reactants? Products? ✓
b. Label the phases s, aq, l, g ✓
c. What is this type of reaction? Single replacement
d. What is the use of the activity series? To aid in determining whether the reaction will take place or not.

2. Describe the characteristics of the following reaction types:
a. decomposition: one reactant, 2 products
b. combustion: usually hydrocarbons burning w/ O_2, products $H_2O + CO_2$ or CO
c. direct combination: one product, also called synthesis.
d. single replacement: product is ionic cmpd & a gas (or element)

3. Identify and balance the following reactions:

a. $2Hg + O_2 \rightarrow 2HgO$ Direct Combination

b. $2PbO_2 \rightarrow 2PbO + O_2$ Decomposition

c. $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ Combustion

d. $3Ba(C_2H_3O_2)_2 + 2Na_3PO_4 \rightarrow Ba_3(PO_4)_2 + 6NaC_2H_3O_2$ Double replacement.

CHAPTER 10 THE MOLE 6.02×10^{23} units / 1 mole

1. One mole is how many units of something? ↑
2. What is the usefulness of the mole? Allows conversion from mass to moles; allows dealing w/ large #'s of molecules & combined w/ molar mass you have a lot of info.
3. What is molar mass? Mass of one mole of something.
4. If you have 5.3g $Ca(OH)_2$, how many moles of calcium hydroxide do you have? How many moles of calcium do you have? Hydroxide?

$\frac{5.3\text{g } Ca(OH)_2}{1} \cdot \frac{1\text{ mol}}{74.10} = .072\text{ moles } Ca(OH)_2$

(40.08 + 32.00 + 2.02)

∴ .072 moles Ca
+
.14 moles OH or hydroxide
or
.144

(13)

5. a. At STP, 1 mole of any gas occupies what volume? 22.4 L

b. This is called molar volume.

c. What is the mass of 235.6L of chlorine gas? $\frac{235.6\text{ L } Cl_2}{1} \cdot \frac{1\text{ mol}}{22.4\text{ L } Cl_2} \cdot \frac{70.9\text{ g}}{1\text{ mol } Cl_2} = 746\text{ g } Cl_2$

6. What is the empirical formula for H_4O_2? H_2O Glucose: $C_6H_{12}O_6$? CH_2O

7. What is the percent composition of $MgCl_2$? $M_{MgCl_2} = 24.31 + 2(35.45) = 95.21\text{ g/mol}$

$\%\text{ comp Mg} = \frac{24.31}{95.21} = .2553 = 25.53\%\text{ Mg}$ $\%\text{ Cl} = \frac{2(35.45)}{95.21} = 74.47\%\text{ Cl}$

8. How many moles in 637.8×10^{23} atoms of carbon?

$\frac{637.8 \times 10^{23}\text{ atoms}}{1} \cdot \frac{1\text{ mole}}{6.02 \times 10^{23}\text{ atoms}} = 106\text{ moles Carbon}$

CHAPTER 12 STOICHIOMETRY

1. What is the very first step in any stoichiometry problem?

Balance the equation!

2. Do the reactants or the products determine how much product(s) is formed?

reactants

3. Consider the following reaction of sodium bicarbonate and citric acid:

$$3\,NaHCO_3 + H_3C_6H_5O_7 \rightarrow 3CO_{2(g)} + 3H_2O_{(l)} + Na_3C_6H_5O_7$$

a. If 2.0 grams of sodium bicarbonate and 0.50g of citric acid are entered into the reaction, determine how much ~~reactant~~ product of CO_2 each will produce. → CO_2

$\frac{2.0\text{ g } NaHCO_3}{1} \cdot \frac{1\text{ mol } NaHCO_3}{84\text{ g}} \cdot \frac{3\text{ mol } CO_2}{3\text{ mol } NaHCO_3} \cdot \frac{22.4\text{ L } CO_2}{1\text{ mol}} = .53\text{ L } CO_2$

$\frac{.50\text{ g } H_3C_6H_5O_7}{1} \cdot \frac{1\text{ mol}}{192\text{ g}} \cdot \frac{3\text{ mol } CO_2}{1\text{ mol } H_3\ldots} \cdot \frac{22.4\text{ L}}{1\text{ mol}} = .175\text{ L } CO_2$ ∴ Citric acid is the limiting reactant.

b. What is the percent yield equation?

$$\%\text{ yield} = \frac{\text{actual yield}}{\text{expected yield}} \times 100\%$$

c. Suppose the above reaction only created 0.15L CO_2, what is the percent yield?

$\frac{.15\text{ L}}{.175} \times 100\% = 88\%$

CHAPTER 17 HEAT IN CHEMICAL REACTIONS

1. What is the difference between exothermic and endothermic reactions?

"heat exits" or is released. → heat "enters" or is needed

2. What type of reaction is the following?

a. $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)} + 2043\ kJ$ EXOTHERMIC

b. $C_{(s)} + H_2O_{(g)} + 113\ kJ \rightarrow CO_{(g)} + H_{2(g)}$ ENDOTHERMIC

3. What is specific heat? *Think of the units.*

$C \Rightarrow \frac{J}{kg°C}$ or $\frac{cal}{g°C}$ or $\frac{J}{g°C}$

4. What is heat? What is the equation for heat?

The transfer of energy. $Q = mC\Delta T$

5. How many calories are needed to raise 2.5L water from 23°C to 90.0°C?

$2.5L = 2.5\ kg \quad Q = 2.5\ kg\left(1000\ \frac{cal}{kg°C}\right)(90.0° - 23°) = \boxed{167{,}500\ cal}$

CHAPTER 14 GASES

1. What are the three major characteristics of gases? 1) pressure 2) temp 3) volume

2. What are the various units of pressure? pascals, kilopascals, atm, mmHg, Torr

760.0 mmHg = 1 atm = 101.3 kPa = 101,300 Pa = 760. 0 Torr

3. What is a manometer? p 428

A device that measures gas pressure,

4. What temperature scale is used in the gas law equations? KELVIN

$-273.15°C = 0K$

5. $-10.00°C = \underline{263.15}\ K$ (+273.15) $\qquad 236.0K = \underline{-37.15}\ °C$ (−273.15)

6. What are the six gas laws? Also, name them.

1) $P_1V_1 = P_2V_2$, $PV = K'$ Boyle's law

2) $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ or $\frac{P}{T} = k$ or $P = kT$ Gay Lussac's law

3) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ or $\frac{V}{T} = K$ or $V = kT$ Charles' Law

4) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ or $\frac{PV}{T} = k$ Combined Gas law

Ideal Gas law

5) $PV = nRT$

$R = .0821\ \frac{atm\,L}{mol\,K}$

∴ n in moles

V in Liters

P in atm

6) $P_T = P_1 + P_2 + \ldots$ (Dalton's law of Partial pressure) (3)

7. If the volume of a gas doubles, what happens to its pressure?
Assume constant temperature.

$PV = k$ P↓ by a factor of $\frac{1}{2}$.

Correction ✗ 8. If the temperature of a gas decreases by a factor of 4, what happens to its pressure? *Assume constant volume.*

$\frac{P}{T} = k$ or $P = kT$ pressure ↓ by a factor of $\frac{1}{4}$ also.

9. If the volume of a gas increases by a factor of 10, what happens to its temperature? *Assume constant* pressure. $\frac{V}{T} = k$ or $V = kT$ ∴ T ↑ by a factor of 10.

10. If the volume of a gas decreases by a factor of 27 (change to $\frac{1}{27}$) and the temperature increases by a factor of 3, what happens to the pressure? *Assume constant* # of moles or molecules.

$\frac{1}{81} = \frac{P\frac{1}{27}V}{3T}$ $\frac{PV}{T} = K$ P ↑ by a factor of 81.

11. If the number of moles of a gas triples, but its temperature and pressure remain constant, what happens to its volume?

$PV = nRT \Rightarrow PV = 3nRT \Rightarrow$ volume triples also.

CHAPTER ~~12~~ 16 SOLUTIONS

1. What are three major properties of a solution? (p 502)

1) Small particles
2) Particles are evenly distributed
3) No separation of particles.

2. Name a solution where its components are not all in the same physical state.

Soda ⇒ $CO_{2(g)}$ & water$_{(l)}$ + sugar$_{(s)}$

3. Describe an alloy and give two examples.

a soln of two solids ⇒ Brass of copper + zinc
Steel of iron + carbon (little)

4. What is the difference between solute and solvent?

Solvent is substance in greater amt / Solute is dissolved in the solvent.

5. What does aqueous mean in regard to solutions?

The solvent is water.

6. Define the ~~four~~ three concentration measurements.

1) molarity: moles / L soln.
2) molality: moles / kg solvent
3) mole fraction: $\frac{\text{moles of component}}{\text{moles of soln.}}$
4) normality: $\frac{\#\text{ equiv (in mole)}}{\text{L of soln.}}$

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7. Which symbol represents molarity? M

8. What is the difference between saturated and supersaturated? saturated: max solute that can be dissolved in a solvent. supersaturated: holding more solute in soln. than can normally be held at that temp. → more than can be dissolved.

9. Which type of solubility is affected by pressure? Solid, liquid, or (gas)

10. Choose "extent of solubility" or "rate of solubility" or both.
a. particle size rate
b. type of solvent/solute extent
c. temperature extent + rate (supersaturated)
d. pressure extent // or (rate)
e. stirring rate
f. grinding rate

11. What does "colligative property" mean? physical props that change w/ conc. changes; not dependent of what the chem nature of the solute/solvent.

12. What are the four colligative properties? Describe how each works.
1) Vapor pressure reduction
2) Boiling pt elevation
3) Freezing pt depression
4) Osmotic pressure
→ relation to boiling pt of a soln. v. a pure solvent. BP ↑ w/ soln. since not as many solvent molecules near the soln.

13. What are the units of solubility? max g solute / 100g H_2O

★ 14. What is the solubility of sodium acetate ($NaC_2H_3O_2$) if 25.0g can dissolve in 15.0g of water?
$$\frac{25.0\text{g } NaC_2H_3O_2}{15.0\text{g } H_2O} = \frac{X\text{g } NaC_2H_3O_2}{100\text{g } H_2O} \Rightarrow X = 166.75\text{g}$$

15. What mass of KOH is needed to make 4.0L of 1.5M solution?
$$\frac{1.5\text{mol KOH}}{1\text{L}} \cdot \frac{4.0\text{L}}{1} \cdot \frac{56.11\text{g}}{1\text{mol KOH}} = 336.66\text{g NaOH} \rightarrow 340\text{g NaOH}$$

16. How many moles of solute in 375ml of 0.800 solution?
$$\frac{.800\text{mol}}{1\text{L}} \cdot \frac{.375\text{L}}{1} = .300\text{mol}$$

17. How many ml of stock HCl (12M), are needed to make 750.0 ml of ~~.25M HCl~~? How much water should you add? [16ml] 25ml

$M_1V_1 = M_2V_2 \Rightarrow 12V_1 = .25(750.0) \Rightarrow V_1 = 15.625\,ml$

18. As the temperature of a gas increases, its solubility decreases.

19. As the temperature of a solid increases, its solubility increases

20. Are the collisions between gas molecules elastic or inelastic? What does this mean?

Elastic. This means that the kinetic energy is conserved.

6

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EXTRA REVIEW QUESTIONS FOR THE 2ND SEM FINAL TEST

1. What's the difference between an Arrhenius acid and base definition and Bronsted-Lowry?
Arrhenius acids → dissociates in water to produce H^+ ions. Bases → dissociates in water to produce OH^- ions.
Bron-Lowry acids → donate H^+ ions. bases → accept H^+ ions

2. What is the only condition that can change equilibrium constant?
temp.

3. Name factors that affect the rate of solubility versus extent of solubility.
a. temperature b. grinding c. air pressure d. nature of solute and solvent
both rate extent (gases) extent

4. Find the percent composition of sulfuric acid. (use molar mass!)
$H_2SO_4 = 2(1.01)+1(32.07)+4(16.00) = 98.09$
H: $\frac{2.02}{98.09} = .0206 = \boxed{2.06\%\ H}$ $\frac{32.07}{98.09} = \boxed{32.7\%\ S}$ $\frac{64.00}{98.09} = \boxed{65.2\%\ O}$

5. Define pH and pOH.
$pH = -\log[H_3O^+]$ $pOH = -\log[OH^-]$

6. Describe LeChatelier's Principle.
Chemical reactions in equilibrium shift left or right to undo changes imposed upon them.

BP = atm press ↑ / P above soln = VP of soln, so atm press = vp of soln.

7. Difference between boiling points of pure solvents and solutions and why (relate to vapor pressure of the solution.) $BP_{soln} > BP_{pure}$ since VP of a solution is reduced (gas particles can't escape as easily ∴ ↑ temp needed to get VP = atm press.
See p. 520-521

8. What is the difference between elastic collisions and inelastic collisions?
Which type of collision occurs between molecules? → Elastic → KE conserved
Inelastic → KE not conserved

F.U. in the exponent

9. For acidic solutions, the concentration of H_3O^+ ions is greater than 1.0×10^{-7} like 1.0×10^{-6}
For basic solutions, the concentration of OH^- ions is greater than 1.0×10^{-7}

10. Describe chemical equilibrium in terms of rate of reactions. fwd reax = reverse reax.

11. The calorimetry equation we used to describe heat transfer is $Q = mc\Delta T$ $*\Delta T = T_f - T_i$
Use this equation to calculate the amount of calories necessary to raise 3.5 g of aluminum from 23.0°C to 35.0°C. The specific heat of aluminum is .168cal/g°C. 4.184 J = 1.000 cal
$Q = 3.5g\left(.168\ cal/g^\circ C\right)(35.0 - 23.0) = \boxed{7.1\ cal}$

12. When a gas sample is kept at constant volume, the pressure and temperature vary in what way? $V = \frac{nRT}{P}$ directly
Use PV=nRT
What if the pressure stays constant, how do volume and temperature vary? $P = \frac{nRT}{V}$ ⇒ directly
What if the temperature remains constant, how do volume and pressure vary? $PV = nRT$ ⇒ inversely
*Describe the ideal gas law. $PV = nRT$

13. Why are standard acids used? Standard bases? To find the concentration of an unknown base, then find the concentration of a unknown base.

14. Describe endpoint.
indicator changes color (permanently) to indicate equal equiv of acid + base have reacted. *Neutralization.

15. What's an aqueous solution?
A solution where water is the solvent.

16. What's molar volume?
The volume that 1 mole of an ideal gas will occupy → 22.4L

17. If you have 234.76 g of Krypton, what is the volume?

$$\frac{234.76g}{1} \cdot \frac{1\ mol}{83.80} \cdot \frac{22.4L}{1\ mol} = \boxed{62.8\ L}$$

18. If you have 3.45×10^{25} atoms of gold, how many moles of gold do you have? What is this mass? $\frac{3.45\times10^{25}\text{ atoms}}{1} \cdot \frac{1\text{ mol}}{6.02\times10^{23}\text{ atoms}} = 57.3\text{ mol Au}$

19. In which type of reaction are the reactants and products always ionic compounds?
double replacement.

20. What type of acid is nitrous acid, phosphoric, hydrochloric, nitric, bromous, carbonic? Choices are monoprotic, diprotic, triprotic.

Nitrous → HNO_2 (mono) Phosphoric H_3PO_4 (tri) Hydrochloric HCl (mono) Nitric HNO_3 Bromous $HBrO_2$ (mono) Carbonic H_2CO_3 (di)

21. How does a catalyst work? reduces activation energy

22. Acid + Base always yields what? What is the name of this type of reaction?
H_2O + salt Neutralization

23. Indicate whether the following solutions are acidic, basic, or neutral:
a. Hydroxide concentration is 1×10^{-9} acidic pOH = 9 ∴ pH = 5
b. Hydronium concentration is 2×10^{-3} acidic pH = 2.7
c. Hydronium concentration is 2×10^{-7} acidic pH = 6.70
d. Hydroxide concentration is 1×10^{-7} neutral pOH = 7

24. Convert the following temperatures: -214°C to Kelvin, -596°C to Kelvin, 98.6K to Celsius. 0k = -273°C $-214 + 273 = 59\text{k}$ $-596°\text{C} + 273 = -323\text{k}$ NOPE CAN'T EXIST! $98.6\text{k} - 273 = -174.4°\text{C}$

25. What's the gram molecular mass of copper? Neon? Nitrogen?
$\mathcal{M}_{Cu} = 63.55\text{ g/mol}$ $\mathcal{M}_{Ne} = 20.18\text{ g/mol}$ $\mathcal{M}_{N_2} = 2(14.01) = 28.02\text{ g/mol}$

26. At -173°C, a gas sample occupies 20.0ml. At what temperature will it occupy 50.0ml? $-173°\text{C} + 273$ $\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow \frac{20.0\text{mL}}{100\text{k}} = \frac{50.0\text{mL}}{x} \Rightarrow 250\text{K} = -23°\text{C}$

27. At 682.5mm Hg, a gas sample's volume is .040L, what volume will it occupy at 68.25mmHg? $P_1 = 682.5\text{mmHg}$ $V_1 = .040\text{L}$ $P_2 = 68.25\text{mmHg}$ $V_2 = ?$ $P_1V_1 = P_2V_2$ $682.5(.040) = 68.25V_2 \Rightarrow V_2 = .40\text{mL}$

28. How much ~~bromium~~ chloride would you need, in grams, to make 50.0ml of 3.5M solution? $3.5\text{M} = \frac{x\text{ mol } CaCl_2}{.0500\text{ L}} \Rightarrow x = .175\text{mol } CaCl_2$ $\frac{.175\text{ mol}}{1} \cdot \frac{110.98}{1\text{ mol}} = 19.4\text{g } CaCl_2$

29. How many moles of hydrochloric acid do you have in 25,0ml of a 3.0M solution?
$3.0 = \frac{x\text{ HCl}}{.0250} \Rightarrow .075\text{ mol HCl}$

30. If you mix 125.0ml of water with 4.50ml of 12.0M NaOH, what's the molarity of your solution? $M_1V_1 = M_2V_2$ $M_1(129.5) = 12.0\text{M}(4.50) \Rightarrow M_1 = .417\text{M}$

31. How does the solubility of a gas and temperature relate?
inversely As T↑ sol. gas↓

32. If a 25.0 ml of H_2O is saturated with 10.0g of NaCl, then what's the solubility of this solution?

$25.0\text{ mL} = 25.0\text{ g}$

$\frac{10.0\text{g NaCl}}{25.0\text{g}} = \frac{40.0\text{g NaCl}}{100.0\text{g } H_2O}$