AP Chemistry
Chapter 3 and 4 Jeopardy

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Round 1 – Chapter 3

Chemical Reactions	Reactions/ Balancing Equations	Molar Mass and % Mass	Empirical/ Molecular Formulas	Stoichiometry	Limiting Reagents/ % Yield
100	100	100	100	100	100
200	200	200	200	200	200
300	300	300	300	300	300
400	400	400	400	400	400
500	500	500	500	500	500

Round 2 – Chapter 4

Click to go to Round 2

Chemical Reactions 100

In a chemical reaction, what are the substances to the left of the yield sign and what are the substances to the right of the yield sign?

Reactants → Products

Chemical Reactions 200

What is the difference in a subscript, a superscript, and a coefficient?

$3SO_4^{2-}$

3 = coefficient

4 = subscript

2- = superscript

Chemical Reactions 300

What are the abbreviations for the states of matter encountered in chemical reactions?

(s) = solid
(l) = liquid
(g) = gas
(aq) = aqueous

Chemical Reactions 400

What is a catalyst and where is it written in a chemical equation?

A catalyst is a substance that speeds up a reaction but is not consumed in the reaction. A catalyst is written above the yield sign.

Chemical Reactions 500

When heat is added as a catalyst, what is written above the yield sign?

Reactions/Balanced Equations 100

Balance the following equation and tell the type of reaction.

$C_5H_{10}O_{2(l)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

$\mathbf{2}C_5H_{10}O_{2(l)} + \mathbf{13}O_{2(g)} \rightarrow \mathbf{10}CO_{2(g)} + \mathbf{10}H_2O_{(g)}$

Combustion reaction

Reactions/Balanced Equations 200

Balance the following equation and tell the type of reaction.

$Mg_3N_{2(s)} + H_2SO_{4(aq)} \rightarrow MgSO_{4(aq)} + (NH_4)_2SO_{4(aq)}$

$Mg_3N_{2(s)} + 4H_2SO_{4(aq)} \rightarrow 3MgSO_{4(aq)} + (NH_4)_2SO_{4(aq)}$

Double displacement

Reactions/Balanced Equations 300

Write the balanced equation and type of reaction: Zinc metal reacts with sulfuric acid to form hydrogen gas and aqueous zinc sulfate.

$Zn_{(s)} + H_2SO_{4(aq)} \rightarrow H_{2(g)} + ZnSO_{4(aq)}$

Single displacement

Reactions/Balanced Equations 400

Write the balanced equation: When liquid phosphorus trichloride is added to water, it reacts to form phosphorous acid and hydrochloric acid.

$$PCl_{3(l)} + 3H_2O_{(l)} \rightarrow H_3PO_{3(aq)} + 3HCl_{(aq)}$$

Reactions/Balanced Equations 500

Write the balanced equation and reaction type: When hydrogen sulfide gas is passed over solid hot iron(III)hydroxide, the resultant reaction produces solid iron(III)sulfide and water vapor.

$3H_2S_{(g)} + 2Fe(OH)_{3(s)} \rightarrow Fe_2S_{3(s)} + 6H_2O_{(g)}$

Double Displacement

Molar Mass and % Mass 100

Calculate the molar mass of potassium permanganate.

$KMnO_4$ = 158 g/mol

Molar Mass and % Mass 200

Calculate the molar mass of chromium(III)sulfate.

$Cr_2(SO_4)_3$ = 392.3 g/mol

Molar Mass and % Mass 300

Calculate the % by mass of oxygen in morphine, $C_{17}H_{19}NO_3$.

16.84% O

Molar Mass and % Mass 400

Calculate the % by mass of carbon in codeine, $C_{18}H_{21}NO_3$.

77.42% C

Molar Mass and % Mass 500

Calculate the % by mass of each element in cocaine, $C_{17}H_{21}NO_4$.

67.33% C
6.93% H
4.62% N
21.12% O

Empirical/Molecular Formulas 100

What is the molecular formula of a compound with an empirical formula of CH_2 and a molar mass of 84 g/mol.

C_6H_{12}

Empirical/Molecular Formulas 200

Give the empirical formula of a compound if a sample contains 11.66g Fe and 5.01g O.

Fe_2O_3

Empirical/Molecular Formulas 300

Determine the empirical formula of a compound that is 21.7% C, 9.6% O, and 68.7% F.

C_3OF_6

Empirical/Molecular Formulas 400

Determine the empirical formula of a compound that is 32.79% Na, 13.02% Al, and 54.19% F.

Na_3AlF_6

Empirical/Molecular Formulas 500

Caffeine contains 49.5% C, 5.15%H, 28.9% N, and 16.5%O by mass and has a molar mass of 195 g/mol. Determine the molecular formula for caffeine.

$C_8H_{10}N_4O_2$

Stoichiometry 100

Calculate the number of N atoms in 0.410 mol NH_3.

2.27×10^{23} N atoms

Stoichiometry 200

How many moles of chloride ions are in 0.2250g of aluminum chloride?

5.737×10^{-3} mol Cl^-

Stoichiometry 300

How many moles of HF are needed to react with 0.300 mol of Na_2SiO_3?

$Na_2SiO_{3(s)} + 8HF_{(aq)} \rightarrow H_2SiF_{6(aq)} + 2NaF_{(aq)} + 3H_2O_{(l)}$

2.40 mol HF

Stoichiometry 400

How many grams of NaN_3 are required to form 10.0g of nitrogen gas?

$2NaN_{3(s)} \rightarrow 2Na_{(s)} + 3N_{2(g)}$

15.5 g NaN_3

Stoichiometry 500

How many grams of NaN_3 are required to produce 10.0 ft^3 of nitrogen gas, about the size of an automotive air bag, if the gas has a density of 1.25 g/L.

$2NaN_{3(s)} \rightarrow 2Na_{(s)} + 3N_{2(g)}$

548g NaN_3

Limiting Reagent/ % Yield 100

What is the percent yield of bromobenzene when 30.0g of benzene reacts with 65.0g of bromine and 42.3g of bromobenzene is produced?

$C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$

70.1%

Limiting Reagent/ % Yield 200

How many moles of Na_2CO_3 can be produced when 1.85 mol NaOH and 1.00 mol CO_2 are allowed to react? How many moles of excess reactant remain?

$2NaOH_{(s)} + CO_{2(g)} \rightarrow Na_2CO_{3(s)} + H_2O_{(l)}$

0.925 mol Na_2CO_3

0.075 mol CO_2 remain

Limiting Reagent/ % Yield 300

How many grams of carbon dioxide form when 1.00g sodium bicarbonate and 1.00g citric acid are allowed to react. How many grams of excess reagent remain?

$3NaHCO_{3(aq)} + H_3C_6H_5O_{7(aq)} \rightarrow 3CO_{2(g)} + 3H_2O_{(l)} + Na_3C_6H_5O_{7(aq)}$

0.524g CO_2

0.238g citric acid remain

Limiting Reagent/ % Yield 400

A solution containing 3.50g sodium carbonate is mixed with one containing 5.00g silver nitrate to form solid silver carbonate and a solution of sodium nitrate. How many grams of sodium carbonate, silver nitrate, silver carbonate, and sodium nitrate are present after the reaction is complete?

$$Na_2CO_{3(aq)} + 2AgNO_{3(aq)} \rightarrow Ag_2CO_{3(s)} + 2NaNO_{3(aq)}$$

0g $AgNO_3$; 1.94g Na_2CO_3; 4.06g Ag_2CO_3; 2.50g $NaNO_3$

Limiting Reagent/ % Yield 500

If you started with 30.0g H_2S and 50.0g O_2, how many grams of S_8 would be produced in a 98% yield?

$8H_2S_{(g)} + 4O_{2(g)} \rightarrow S_{8(l)} + 8H_2O_{(g)}$

28g S_8

Vocabulary	Solutions and Electrolytes	Precipitates	Acid-Base Reactions	Oxidation-Reduction Reactions	Concentration and Stoichiometry
200	200	200	200	200	200
400	400	400	400	400	400
600	600	600	600	600	600
800	800	800	800	800	800
1000	1000	1000	1000	1000	1000

Vocabulary 200

What are the definitions of an acid and a base?

An acid produces H^+ ions in solution (proton donor).
A base produces OH^- ions in solution (proton acceptor).

Vocabulary 400

Define solute, solvent, and solution.

A solute is a substance that has been dissolved.
A solvent is the dissolving medium of a solution and is present in the greatest amount.
A solution is a homogeneous mixture.

Vocabulary 600

What is the difference in oxidation and reduction?

Oxidation is the loss of electrons.
Reduction is the gain of electrons.

Vocabulary 800

What is the difference in a complete ionic equation, a net ionic equation, and spectator ions?

A complete ionic equation shows all aqueous substances as ions.
A net ionic equation shows only the substances or ions that actually react.
A spectator ion is an ion that is not directly involved in the reaction.

Vocabulary 1000

What is the difference in the equivalence point and the end point of a titration?

The equivalence point is when the molarity of H^+ and OH^- ions are equal.
The end point is when the indicator changes colors.

Solutions and Electrolytes 200

What is the difference in a strong electrolyte, weak electrolyte, and a nonelectrolyte?

A strong electrolyte fully breaks into ions.
A weak electrolyte partially breaks into ions.
A nonelectrolyte does not break into ions.

Solutions and Electrolytes 400

You are presented with three white solids, A, B, and C, which are glucose, NaOH, and AgBr. Solid A dissolves in water to form a conducting solution. B is not soluble in water. C dissolves in water to form a nonconducting solution. Identify A, B, and C.

A = NaOH, B = AgBr, C = glucose

Solutions and Electrolytes
600

Specify which ions are present in solution upon dissolving each of the following substances in water:

a. $ZnCl_2$ — Zn^{2+}, $2Cl^-$

b. HNO_3 — H^+, NO_3^-

c. $(NH_4)_2SO_4$ — $2NH_4^+$, SO_4^{2-}

d. $Ca(OH)_2$ — Ca^{2+}, $2OH^-$

Solutions and Electrolytes 800

Formic acid, HCOOH, is a weak electrolyte. What solute particles are present in an aqueous solution of this compound? Write the chemical equation for the ionization of HCOOH.

HCOOH, H^+, $COOH^-$

$HCOOH \leftrightarrow H^+ + COOH^-$

Solutions and Electrolytes 1000

Classify each of the following substances are nonelectrolyte, weak electrolyte, or strong electrolyte in water.

a. H_2SO_3 Weak electrolyte

b. C_2H_5OH Nonelectrolyte

c. NH_3 Weak electrolyte

d. $KClO_3$ Strong electrolyte

e. $Cu(NO_3)_2$ Strong electrolyte

Precipitates 200

Predict whether each of the following compounds is soluble or insoluble in water:

a. $NiCl_2$ Soluble

b. Ag_2S Insoluble

c. Cs_3PO_4 Soluble

Precipitates 400

Will precipitation occur when Na_2CO_3 and $AgNO_3$ are mixed? If so, write a balanced equation for the reaction.

Yes.

$Na_2CO_{3(aq)} + 2AgNO_{3(aq)} \rightarrow Ag_2CO_{3(aq)} + 2NaNO_{3(aq)}$

Precipitates 600

Name the spectator ions that are present when solutions of $Pb(NO_3)_2$ and Na_2S are mixed.

NO_3^- and Na^+

Precipitates 800

Separate samples of a solution of an unknown salt are treated with dilute solutions of HBr, H_2SO_4, and NaOH. A precipatate forms in all three cases. Which of the following cations could the solution contain: K^+, Pb^{2+}, Ba^{2+}?

Pb^{2+}

Precipitates 1000

An unlabeled bottle contains a solution of one of the following: $AgNO_3$, $CaCl_2$, or $Al_2(SO_4)_3$. A friend suggests that you test a portion of the solution with $Ba(NO_3)_2$ and then with NaCl solutions. Explain how these two tests together would be sufficient to determine which salt is present in the solution.

$Ba(NO_3)_2$ would form a precipitate with $Al_2(SO_4)_3$. NaCl would form a precipitate with $AgNO_3$. $CaCl_2$ would not form a precipitate with either solution.

Acid-Base Reactions 200

Explain which of the following solutions has the largest concentration of solvated protons:

a. 0.2M LiOH

b. 0.2M HI

c. 1.0M CH_3OH

0.2M HI – that is the only one that dissociates to form H^+.

Acid-Base Reactions 400

Label the following substances are strong or weak acid, strong or weak base, a salt, or none.

a. HF **Weak acid**

b. CH_3CN **None**

c. $NaClO_4$ **Salt**

d. $Ba(OH)_2$ **Strong base**

Acid-Base Reactions 600

Complete and balance the following molecular equation, and then write the net ionic equation:

$HBr_{(aq)} + Ca(OH)_{2(aq)} \rightarrow$

$2HBr_{(aq)} + Ca(OH)_{2(aq)} \rightarrow 2H_2O_{(l)} + CaBr_{2(aq)}$

Net ionic equation:

$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

Acid-Base Reactions 800

Complete and balance the following molecular equation, and then write the net ionic equation:

$Cu(OH)_{2(s)} + HClO_{4(aq)} \rightarrow$

$Cu(OH)_{2(s)} + 2HClO_{4(aq)} \rightarrow 2H_2O_{(l)} + Cu(ClO_4)_{2(aq)}$

Net ionic equation:

$Cu(OH)_{2(s)} + 2H^+_{(aq)} \rightarrow H_2O_{(l)} + Cu^{2+}_{(aq)}$

Acid-Base Reactions 1000

Write the molecular and net ionic equation when solid magnesium carbonate reacts with an aqueous solution of perchloric acid.

$MgCO_{3(s)} + 2HClO_{4(aq)} \rightarrow H_2O_{(l)} + CO_{2(g)} + Mg(ClO_4)_{2(aq)}$

Net ionic equation:

$MgCO_{3(s)} + 2H^+_{(aq)} \rightarrow H_2O_{(l)} + CO_{2(g)} + Mg^{2+}_{(aq)}$

Oxidation-Reduction Reactions 200

Determine the oxidation numbers for each element in MnO_4^-.

Mn = +7

O = -2

Oxidation-Reduction Reactions 400

Which element is oxidized and which element is reduced in the following reaction:

$3Fe(NO_3)_{2(aq)} + 2Al_{(s)} \rightarrow 3Fe_{(s)} + 2Al(NO_3)_{3(aq)}$

Oxidized = Al

Reduced = Fe

Oxidation-Reduction Reactions 600

Which element is oxidized and which element is reduced in the following reaction:

$$PbS_{(s)} + 4H_2O_{2(aq)} \rightarrow PbSO_{4(s)} + 4H_2O_{(l)}$$

Oxidized = S

Reduced = O

Oxidation-Reduction Reactions 800

Write the balanced equation for the following reactions. If no reaction occurs, then write NR.

a. Iron metal is added to a copper (II) nitrate solution.

$$Fe_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow Cu_{(s)} + Fe(NO_3)_{2(aq)}$$

b. Zinc metal is added to a solution of magnesium sulfate.

Oxidation-Reduction Reactions 1000

Write the balanced molecular and net ionic equations for the reaction between manganese and dilute sulfuric acid. Identify which element is reduced and which is oxidized.

$Mn_{(s)} + H_2SO_{4(aq)} \rightarrow H_{2(g)} + MnSO_{4(aq)}$

$Mn_{(s)} + 2H^+_{(aq)} \rightarrow H_{2(g)} + Mn^{2+}_{(aq)}$

Oxidized = Mn

Reduced = H

Concentration and Stoichiometry 200

Calculate the molar concentration of a solution containing 14.75g of calcium nitrate in 1.375L of solution.

0.06537M $Ca(NO_3)_2$

Concentration and Stoichiometry 400

Indicate the concentration of each ion or molecule present in a mixture of 45.0mL of 0.272M NaCl and 65.0mL of 0.0247M ammonium carbonate. Assume that the volumes are additive.

0.111M Na^+, 0.111M Cl^-, 0.0292M NH_4^+, 0.0146M CO_3^{2-}

Concentration and Stoichiometry 600

You have a stock solution of 14.8M NH_3. How many milliliters of this solution should you dilute to make 1000.0mL of 0.250M NH_3?

16.9mL

Concentration and Stoichiometry 800

What volume of 0.115M $HClO_4$ solution is needed to neutralize 50.00mL of 0.0875M NaOH?

38.0mL

Concentration and Stoichiometry 1000

If 45.3mL of 0.108M HCl solution is needed to neutralize a solution of KOH, how many grams of KOH must be present in the solution?

0.275g KOH