Lecture 1: Qualitative aspects of ionic solutions and reactions (slides 1-28)

Slides 1-2:

Discussion on the importance of ionic solutions:

Have you ever wonder why the water we drink, your tears, the water of the rivers, the rain and the oceans all contain ions?

- Importance in general:

Most of the reactions you will see in the lab are in ionic solutions. Many ionic solutions are spontaneously formed (*e.g.*, from salts and polar solvents such as water): *polar solvents and solvation*. The solvent cage affects the nature and behavior of compounds. The chemical properties of solvated species are strongly determined by the nature of the solvent.

- Importance in biological systems:

Ionic solutions assist in transporting nutrients and waste products in and out of the cell Ionic aqueous solutions are necessary for all chemical reactions responsible for digestive, absorption, circulatory and excretory functions.

Slides 3-4:

Discussion on Strong Electrolytes:

How do we know that ions are present in solutions? Ionic solutions conduct electricity!

Introduce the concept of *strong electrolytes*.

Slides 5-6:

Discussion on Weak Electrolytes:

Are there any compounds that dissociate only to a small extent? If so, would you expect them to conduct more or less than strong electrolytes?

Introduce the concept of *dynamical equilibrium between ionized and non-ionized forms* of weak electrolytes.

Slide 7:

Discussion on Nonelectrolytes:

Are there any compounds that do not form ions when the dissolve in liquids?

Sugar in water and the role of dipole-dipole interactions.

Slide 8-9:

Discussion on solubility of ionic compounds:

Are there any ionic compounds that are insoluble in water?

Introduce the concept of *dynamical equilibrium between ionized and non-ionized forms* of an electrolyte.

General guidelines to predict solubility of ionic compounds:

- *Soluble compounds* are:

  salts of Na^+, K^+, NH_4^+, NO_3^-, ClO_3^-, ClO_4^-, $CH_3CO_2^-$,

salts of Cl^-, Br^-, I^-, except for halides of Ag^+, Hg_2^{2+} and Pb^{2+}

compounds of F^-, except for fluorides of Mg^{2+},Ca^{2+}, Sr^{2+},Ba^{2+} and Pb^{2+}

- *Insoluble compounds* are:

Salts of CO_3^{2-}, PO_4^{3-},$C_2O_4^{2-}$,CrO_4^{2-},S^{2-}, metal oxides and hydroxides, except for salts of NH_4^+ and alkali metal cations.

Common minerals often contain anions that make them insoluble in water.

Comment on precipitation reactions:

Have you ever thought that by mixing two *liquids* you can make a *solid*?

We can make solutions with combinations of ions that produce insoluble substances.

Slides 10-13:

Are there any electrolytes that do not result from salts and water? What other ionic compounds do you already know?

Introduce strong and weak *acids* as electrolytes that are produce protons according to reactions at dynamical equilibrium that are almost completely displaced, or only slightly displaced towards products.

Slide 14:

How can acids be made in the clouds by gases that dissolve in microdroplets of water?

Discussion of acid rain: an environmental problem resulting from hydrolysis of nonmetal oxides.

Slides 15-16:

Are there any other electrolytes besides those that result from salts or acids and water?

Introduce strong and weak *bases* as electrolytes that are produce HO^- according to reactions at dynamical equilibrium that are almost completely displaced, or only slightly displaced, towards products.

Slides 17:

Do you know what is a basic oxide?

Oxides, like lime can produce HO^- ions and therefore are known as *basic* oxides. These are extensively used in pollution control, in water treatment and in agriculture. Do you know what's the origin of the expression "in the limelight"?

Slide 18:

What are the most common acids and bases?

Make sure you know each of these substances and whether they are strong or weak acids and bases.

Slide 19-20:

What are *net-ionic* equations?

Equations where only solvated ions and nonelectrolytes (insoluble compounds, soluble neutral species and gases) are included.

How would you balance a net-ionic equation?

Balancing mass and charge. Introduce the concept of ‘spectator ions’ (remember that while mathematically ‘spectators’, these ions are often chemical ‘players’ in the reaction mechanisms and can affect the speed and extent of a chemical reaction).

First, decide what ions are formed from reactants. Next, determine if an ion from one reactant will combine with an ion from another reactant to form an insoluble compound. Finally, eliminate ions that appear on both sides of the equation.

Slide 21-25:

What are *exchange* reactions?

Reactive compounds swap ionic species during precipitations, acid-base and gas-forming reactions. The driving force is the formation of a chemical species that are solid (slide 22), water (slide 23-25), or gases (slides 26-28).

What is the net ionic-equation for the reactions between a strong acid and a strong base?

Neutralization reactions: Formation of water.

Is it possible to clean a spill of sulfuric acid by using basic oxides such as lime? (40-50 billion kg of (H_2SO_4) are annually made in the USA. While extensively used in the industry of fertilizers, batteries, etc., sulfuric acid can also be a nasty pollutant since it reacts with most organic and biological systems.

Slide 26-28:

Introduce reactions of metal carbonates and water and the equilibrium between CO_2, H_2CO_3, HCO_3^- and CO_3^{2-}

Why does the dough rises when you bake a cake? What is the gas forming reaction responsible for dough-rising?

Tartaric acid and bicarbonate, both in the baking powder, react in the moist batter to produce tartrate ions, water and $CO_2(g)$.

What other gas forming reactions do you know?

Review Table 5.3. In order to balance the net-ionic gas-forming reaction, first decide what ions are formed from reactants. Next, determine if an ion from one reactant will combine with an ion from another reactant to form a gas. Finally, eliminate ions that appear on both sides of the equation.

Lecture 2: Quantitative aspects of ionic solutions and reactions (slides 29-52)

Slide 29:

Discussion on the importance of quantitative studies of chemical reactions: Comment on possible problems where the quantitative analysis of chemical reaction is crucial. Examples: (1) Cleaning a spill of H_2SO_4 with lime: how much lime would you need? (2) Removing a certain amount of Zn accumulated in an industrial reactor: how much acid (e.g., HCl) would you buy to dissolve it?

Slides 30:

What's the main difference between the solute and the solvent in a solution? Explain that the solute participates in the chemical reaction while the solvent remains unchanged.

Slides 31:

What is the concentration of a solution? Why is it important to know the concentration?

Define the concentration as the number of moles per volume. Explain that the concentration of a solution is important because it allows one to determine the number of moles from a measurement of the volume.

Slides 32:

How would you make accurate measurements of masses and volumes?

Introduce volumetric glassware. Make the distinction between volume of the solvent and volume of the solution (especially when the solvent is water and the solute comes with some water).

Slides 33-36:

When computing concentrations:

(1) Make sure you convert the mass of solute into moles first. Note that the mass of $NiCl_2 \cdot 6\ H_2O$ that you would need to weigh in order to have a certain number of moles *n* of the solute $NiCl_2$ is *n* times the molecular weight of $NiCl_2 \cdot 6\ H_2O$, that is larger than *n* times the molecular weight of $NiCl_2$.

(2) The volume of interest is the volume of the *solution* (not volume of the solvent). Note that if the solute comes with some solvent already (*e.g.*, $NiCl_2 \cdot 6\ H_2O$) the volumes of solution and solvent are different!

(3) When computing concentrations of ions, first compute the concentration of the solute. Then, consider how many ions per molecule of solute you will have in the solution.

Slides 37:

How would you prepare a solution of a desired concentration in the lab?

Discuss different methods.

Slides 38-42:

'Diluting a soup': What volume V of water you need to add to a volume V_1 of a solution of concentration M_1 in order to dilute it to a concentration M_2?

Note that the total number of moles of solute is the same, after and before diluting the concentrated solution. Therefore: $M_1 * V_1 = M_2 * V_2$. Solve for V_2 and obtain $V = V_2 - V_1$.

Slides 43:

What volume V_1 of a solution of concentration M_1 you need to take and with how much water you need to dilute it in order to make a certain volume V_2 of a solution of concentration M_2? Note that the total number of moles of solute is the same, after and before diluting the concentrated solution. Therefore: $M_1 * V_1 = M_2 * V_2$

Slides 44-46:

How to compute pH from $[H^+]$? Make sure you use the 'log' key of your calculator, not the 'ln' key.

Always check your result by verifying that: $10^{-pH} = [H^+]$.

Slides 47-49:

Explain that acid-base titration is a technique to determine the concentration of a solution by neutralization with a standard.

Introduce, as an example, a solution of NaOH whose concentration is only approximately known since it was prepared by dissolving in water a certain mass of (highly hygroscopic) NaOH pellets.

Determine its concentration by titrating a volume of that solution of NaOH (of only approximately known concentration) with a *standard solution* of oxalic acid (a solution that was prepared by dissolving in water a certain mass of oxalic acid that can be easily purified and is not hygroscopic).

Explain what is a buret, an indicator and the equivalence point. Emphasize that at the equivalence point the number of moles of added H^+ equals the number of moles of added HO^-. Not necessarily, moles of the acid equal moles of the base.

Slides 50-52:

Explain the problem discussed in slides 47-50 with actual numbers.

Lecture 3: Quantitative aspects of ionic solutions and reactions (slides 53-77)

Slides 53-56:

Have you ever wondered how chemists determine food nutrition labels (*e.g.*, sodium 0.05%)? Brief discussion on quantitative analytical methods. Talk about pH-meters and titrations as possible quantitative techniques for determining H^+ concentrations. Illustrate the discussion with a specific example: determination of the percentage of malic acid in apples. Emphasize the need to find first the number of *moles* of base necessary to neutralize the acid. Then, convert into mass and then into percentage mass of sample.

Slides 57:

How would you report $[H^+]$ as pH? Make sure you use the 'log' key of your calculator, not the 'ln' key. Always verify that: $10^{-pH} = [H^+]$.

Slides 58-61:

Example of a gas forming reaction: consider the problem of removing a certain amount of Zn accumulated in an industrial reactor: How would you remove it? Soap? Don't think so!: Zn can be dissolved with acid.

How much HCl 0.25M would you need to dissolve 10 g of Zn? Emphasize the need to find first the number of *moles* of Zn. Then, use the stoichiometric coefficients of the *balanced* reaction to obtain the number of moles of acid. Finally, convert moles into volume of acid by using the concentration.

Slides 62:

Introduce redox reactions. Processes driven by the exchange of *electrons (*not ions*)* between chemical species. Emphasize that redox reactions might at the same time form gases, solids, or solvent.

Slides 63:

Oxidation numbers: Review reductions and oxidations and introduce *oxidation numbers* for 'book keeping' the number of electrons assigned to chemical species.

Slides 64:

Why redox species exchange electrons? Redox reactions redistribute electrons among chemical species simply because electrons have more affinity for certain chemical species than for others. After the redistribution takes place, the system is more stable. Emphasize that if a species is oxidized, then another species must be reduced because the # of electrons is conserved. Introduce the concepts of *oxidizing* and *reducing* species as species that are *reduced* and *oxidized*, respectively.

Slides 65:

The broad picture: discuss the impact of redox reactions in modern technology.

Slides 66-68:

Definitions of oxidation numbers. Emphasize that these definitions *formally* assign #'s of electrons to individual atoms. Therefore, they are useful for identifying whether a chemical species is oxidized or reduced (when the oxidation number increases or decreases, respectively). Emphasize that the *partial atomic charges* hardly ever correspond to the *formal oxidation numbers*.

Slides 69:

Go over specific examples. Apply the guidelines introduced in slides 66-68. Find out whether students can correctly compute oxidation numbers.

Slides 70-72:

Recognizing a redox reaction from the analysis of changes in formal oxidation numbers.

Introduce half-reactions.

Explain how to balance the overall redox reaction by balancing both masses and charges. Discuss how to balance redox reactions in basic/acidic conditions.

Slide 73:

Discuss common oxidizing and reducing agents. Can water be an oxidizing agent?

Discuss the effect of metal oxidation in terms of changes in formal oxidation numbers as correlated with 'gain' of oxygen atoms (*i.e.*, rust formation).

Slide 74:

Expand the discussion of slide 73 to a general/comparative discussion in terms of 'gain/loss' of electrons, oxygen and halogen atoms.

Slide 75-77:

Illustrate redox reaction with several examples. Ask the students to identify oxidizing/reducing agents, changes in oxidation numbers, gain/loss of oxygen, etc.

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Chapter 1 (397847)

About this Assignment

Description
Matter and Measurement

Instructions
Matter and Measurement

1. KT6 1.P.014. [489836] Show Details

The cup is a volume measure widely used by cooks in the United States. One cup is equivalent to 237 mL. If 1 cup of oil has a mass of 215 g, what is the density of the oil (in grams per cubic centimeter)?

4.0 ☑ _____ g/cm^3

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2. KT6 1.P.016. [489864] Show Details

Iron pyrite is often called "fool's gold" because it looks like gold. Suppose you have solid that looks like gold, but you believe it to be fool's gold. The sample has a mass of 23.5 g. When the sample is lowered into the water in a graduated cylinder, the water level rises from 45.3 mL to 46.5 mL. Is the sample fool's gold (d = 5.00 g/cm^3) or "real" gold (d = 19.3 g/cm^3)?

- ○ real gold
- ○ fool's gold

Give the density of this solid, to support your answer.

4.0 ☑ _____ g/cm^3

---

3. KT6 1.P.019. [467479] Show Details

Make the following temperature conversions.

℃	K
(a) 19	4.0 ☑ _____
(b) 4.0 ☑ _____	361
(c) 71	4.0 ☑ _____

4. KT6 1.P.026. [489857] Show Details

Some soft drinks are sold in bottles with a volume of 1.5 L. What is this volume in milliliters?

4.0 ☑ _____ mL

What is this volume in cubic centimeters?

4.0 ☑ _____ cm^3

What is this volume in cubic decimeters?

4.0 ☑ _____ dm^3

---

5. KT6 1.P.043. [467213] Show Details

The anesthetic procaine hydrochloride is often used to deaden pain during dental surgery. The compound is packaged as a 10.% solution (by mass; d = 1.0 g/mL) in water. If your dentist injects 0.70 mL of the solution, what mass of procaine hydrochloride (in milligrams) is injected?

4.0 ☑ _____ mg

---

6. KT6 1.P.080.Tutor. [510538] Show Details

Tutorial Question

If you have trouble answering the main question(s) below, a tutorial will guide you through the solution process.

Homework 1.80

MAIN QUESTION

Question

Carry out the following calculation and report the answer in the correct number of significant figures.

$$(168)\left[\frac{23.56 - 2.3}{1.248 \times 10^3}\right] =$$

Answer

Enter a response, then Submit.

Submit

Question has not been submitted for scoring.

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7. KT6 1.P.094.Practice. [510118] Show Details

Answer all parts of the following question to receive credit.

Homework 1.94

MAIN QUESTION

Question 1 of 2

When you heat popcorn, it pops because it loses water explosively. Assume a kernel of corn, with a mass of 0.125 g, has a mass of only 0.104 g after popping.

What percentage of its mass did the kernel lose on popping?

Answer

Enter a response, then Submit.

____ %

Submit

Question has not been submitted for scoring.

---

8. KT6 1.P.104.Tutor. [509975] Show Details

Tutorial Question

If you have trouble answering the main question(s) below, a tutorial will guide you through the solution process.

Homework 1.104

MAIN QUESTION

Question

A spherical metal ball has a mass of 6.823 g and a diameter of 7.66 mm. What is the density of the metal, in g/cm^3?

The volume of a sphere $= \frac{4}{3}\pi r^3$, where r = radius.

Answer

Enter a response, then Submit.

_____ **g/cm^3**

Submit

Question has not been submitted for scoring.

---

9. KT6 1.P.109.Tutor. [510264] Show Details

Tutorial Question

If you have trouble answering the main question(s) below, a tutorial will guide you through the solution process.

Homework 1.109

MAIN QUESTION

Question

Suppose you have a cylindrical glass tube with a thin capillary opening, and you wish to determine the diameter of the capillary. You can do this experimentally by weighing a piece of the tubing before and after filling a portion of the capillary with mercury. Using the following data, calculate the diameter of the capillary, in millimeters.

- Mass of tube before adding mercury 3.263 g
- Mass of tube after adding mercury 3.647 g
- Length of capillary filled with mercury 21 mm
- Density of mercury 13.546 g/cm^3
- Volume of cylindrical capillary filled with mercury = $(\pi)(\text{radius})^2(\text{length})$

Answer

Enter a response, then Submit.

_____ mm

Submit

Question has not been submitted for scoring.

---

10. KT6 1.P.039. [467523] Show Details

A red blood cell has a diameter of 7.5 µm (micrometer).

(a) What is this dimension in meters?
4.0 _____ m

(b) What is this dimension in nanometers?
4.0 _____ nm

(c) What is this dimension in picometers?
4.0 _____ pm

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Chapter 2 (397853)

About this Assignment

Description
Atoms and Elements

Instructions
Atoms and Elements

1. KT6 2.P.009. [467619] Show Details

Give the mass number of each of the following atoms.

(a) iron with 30 neutrons

(b) titanium with 26 neutrons

(c) sodium with 12 neutrons

2. KT6 2.P.012. [489869] Show Details

Give the complete symbol ($^{A}_{Z}X$) for each of the following atoms. (Enter the symbol with the first (raised) number in the first box, the second (lower) number in the second box, and the element in the third box.)

(a) fluorine with 10 neutrons

(b) arsenic with 42 neutrons

(c) calcium with 20 neutrons

3. KT6 2.P.014. [467513] Show Details

How many electrons, protons, and neutrons are there in the following atoms?

(a) boron-11, ^{11}B	(b) bismuth-205, ^{205}Bi	(c) calcium-40, ^{40}Ca
electrons	electrons	electrons
protons	protons	protons
neutrons	neutrons	neutrons

4. KT6 2.P.016. [467370] Show Details

Radioactive americium-241 is used in household smoke detectors and in bone mineral analysis. Give the number of electrons, protons, and neutrons in an atom of americium-241.

electrons

protons

neutrons

---

5. KT6 2.P.020. [489878] Show Details

Strontium has four stable isotopes. Strontium-84 has a very low natural abundance, but ^{86}Sr, ^{87}Sr, and ^{88}Sr are all reasonably abundant. Knowing that the atomic weight of strontium is 87.62, which of the more abundant isotopes predominates?

- ^{86}Sr
- ^{87}Sr
- ^{88}Sr

---

6. KT6 2.P.021. [467330] Show Details

Verify that the atomic mass of lithium is 6.94, given the following information.

^{6}Li, mass = 6.015121 amu; percent abundance = 7.50%

^{7}Li, mass = 7.016003 amu; percent abundance = 92.50%

---

7. KT6 2.P.041.INT. [502087] Show Details

Homework 2.41

MAIN QUESTION

Question

Classify the following elements as metals, metalloids, or nonmetals.

Answer

Select responses, then Submit.

N	○ metal	○ metalloid	○ nonmetal
Na	○ metal	○ metalloid	○ nonmetal
Ni	○ metal	○ metalloid	○ nonmetal
Ne	○ metal	○ metalloid	○ nonmetal
Np	○ metal	○ metalloid	○ nonmetal

Submit

Question has not been submitted for scoring.

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8. KT6 2.P.053. [489833] Show Details

Reviewing the periodic table.

(a) Name an element in Group 2A.

(b) Name an element in the third period.

(c) Which element is in the fourth period in Group 4A?

(d) Which element is in the fifth period in Group 6A?

(e) Which halogen is in the fifth period?

(f) Which alkaline earth element is in the third period?

(g) What noble gas element is in the fourth period?

(h) Name the nonmetal in Group 6A and the second period.

(i) Name a metalloid in the fourth period.

9. KT6 2.P.077.Tutor. [510546] Show Details

Tutorial Question
If you have trouble answering the main question(s) below, a tutorial will guide you through the solution process.

Homework 2.77

MAIN QUESTION

Question

A cylindrical piece of sodium is 12.51 cm long and has a diameter of 4.2 cm. The density of sodium is 0.971 g/cm^3. How many moles does the piece of sodium contain?
[The volume of a cylinder is V = $\pi \cdot r^2 \cdot$length.]

Answer

Enter a response, then Submit.

mol Na

Submit

Question has not been submitted for scoring.

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10. KT6 2.P.031.Tutor. [510839] Show Details

Tutorial Question
If you have trouble answering the main question(s) below, a tutorial will guide you through the solution process.

Homework 2.31

MAIN QUESTION

Question

You are given 1.0-g samples of B, Cl, Fe, U, and W. Which sample has the largest number of atoms?

Enter the symbol for the element.

Answer

Enter a response, then Submit.

Submit

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Chapter 3 (397902)

About this Assignment

Description
Molecules, ions and Compounds

Instructions
Molecules, ions and Compounds

1. KT6 3.P.008. [467172] Show Details

Give the symbol, including the correct charge, for each of the following ions. (Type your answer using the format [NO3]- for NO_3^-.)

(a) dihydrogen phosphate ion

(b) perchlorate ion

(c) phosphate ion

(d) hypochlorite ion

(e) sulfate ion

(f) sulfite ion

2. KT6 3.P.019. [467313] Show Details

Name each of the following ionic compounds.

(a) K_2S

(b) $NiSO_4$

(c) $KMnO_4$

(d) $(NH_4)_3PO_4$

3. KT6 3.P.032. [467550] Show Details

Calculate the molar mass of each of the following compounds.

(a) $Fe(C_6H_{11}O_7)_2$, iron(II) gluconate, a dietary supplement
g/mol

(b) $CH_3CH_2CH_2CH_2SH$, butanethiol, has a skunk-like odor
g/mol

(c) $C_{20}H_{24}N_2O_2$, quinine, used as an antimalarial drug
g/mol

4. KT6 3.P.036. [489882] Show Details

Assume you have 0.250 mol of each of the following compounds. What mass of each is present?

(a) $C_{14}H_{10}O_4$, benzoyl peroxide, used in acne medications
4.0 ☑ [ ] g

(b) $Pt(NH_3)_2Cl_2$, cisplatin, a cancer chemotherapy agent
4.0 ☑ [ ] g

---

5. KT6 3.P.041. [467590] Show Details

Calculate the mass percent of each element in the following compounds, to the nearest 0.1%.

(a) PbS, lead (II) sulfide, galena
%Pb
4.0 ☑ [ ] %
%S
4.0 ☑ [ ] %

(b) NH_4NO_3, ammonium nitrate, a fertilizer
%H
4.0 ☑ [ ] %
%O
4.0 ☑ [ ] %
%N
4.0 ☑ [ ] %

(c) $MgCO_3$, magnesium carbonate
%Mg
4.0 ☑ [ ] %
%C
4.0 ☑ [ ] %
%O
4.0 ☑ [ ] %

---

6. KT6 3.P.058. [467522] Show Details

The "alum" used in cooking is potassium aluminum sulfate hydrate, $KAl(SO_4)_2 \cdot x\ H_2O$. To find the value of x, you can heat a sample of the compound to drive off all of the water and leave only $KAl(SO_4)_2$. Assume you heat 4.74 g of the hydrated compound and that the sample loses 2.16 g of water. What is the value of x?
[ ]

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7. KT6 3.P.013. [467292] Show Details

For each of the following compounds, give the formula (without charge), the charge, and the number of each ion that makes up the compound. (Type your answer using the format CO2 for CO_2.)

(a) K_2S	(b) $Ca(CH_3CO_2)_2$	(c) $Ca(ClO)_2$
cation	cation	cation
formula [ ]	formula [ ]	formula [ ]
charge [ ]	charge [ ]	charge [ ]
# of ions present	# of ions present	# of ions present

anion
formula
charge
# of ions present

anion
formula
charge
# of ions present

anion
formula
charge
# of ions present

(d) $Ti(SO_4)_2$
cation
formula
charge
# of ions present

anion
formula
charge
# of ions present

(e) $Mg(CH_3CO_2)_2$
cation
formula
charge
# of ions present

anion
formula
charge
# of ions present

8. KT6 3.P.022. [467305] Show Details

Give the formula for each of the following ionic compounds. (Type your answer using the format Al(OH)3 for $Al(OH)_3$.)

(a) ammonium phosphate

(b) magnesium perchlorate

(c) sodium sulfite

(d) potassium sulfide

(e) barium nitrite

9. KT6 3.P.027. [467583] Show Details

Give the name for each of the following binary, nonionic compounds.

(a) NF_3

(b) HI

(c) SCl_2

(d) PF_5

---

10. KT6 3.P.039. [489842] Show Details

Sulfur trioxide, SO_3, is made industrially in enormous quantities by combining oxygen and sulfur dioxide, SO_2. What amount (moles) of SO_3 is represented by 2.00 kg of sulfur trioxide?

4.0 mol

How many molecules?

4.0 molecules

How many sulfur atoms?

4.0 atoms

How many oxygen atoms?

4.0 atoms

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Chapter 4 (397919)

About this Assignment

Description
Chemical Equations and Stoichiometry

Instructions
Chemical Equations and Stoichiometry

1. KT6 4.P.006. [489847] Show Details

Balance the following equations and name each reactant and product. (Use the lowest possible coefficients.)

(a) [ ] $SO_2(g)$ + [ ] $HF(l)$ → [ ] $SF_4(g)$ + [ ] $H_2O(l)$

products

SF_4

H_2O

(b) [ ] $NH_3(aq)$ + [ ] $O_2(aq)$ → [ ] $NO(g)$ + [ ] $H_2O(l)$

products

NO

H_2O

(c) [ ] $BF_3(g)$ + [ ] $H_2O(l)$ → [ ] $HF(aq)$ + [ ] $H_3BO_3(aq)$

products

HF

H_3BO_3

2. KT6 4.P.010. [489839] Show Details

The balanced equation for a reaction in the process of reducing iron ore to the metal is shown below.

$$Fe_2O_3(s) + 3\ CO(g) \rightarrow 2\ Fe(s) + 3\ CO_2(g)$$

(a) What is the maximum mass of iron, in grams, that can be obtained from 495 g of iron(III) oxide?

4.0 [ ] g

(b) What mass of CO is required to react with 308 g of Fe_2O_3?

4.0 [ ] g

3. KT6 4.P.026. [489881] Show Details

Aspirin, $C_6H_4(OCOCH_3)CO_2H$, is produced by the reaction of salicylic acid, $C_6H_4(OH)CO_2H$, and acetic anhydride $(CH_3CO)_2O$.

$C_6H_4(OCOCH_3)CO_2H(s) + (CH_3CO)_2O(l) \rightarrow C_6H_4(OCOCH_3)CO_2H(s) + C_6H_4(OH)CO_2H(l)$

If you mix 100. g of each of the reactants, what is the maximum mass of aspirin that can be obtained?
4.0 [ ] g

---

4. KT6 4.P.031. [467436] Show Details

A mixture of $CuSO_4$ and $CuSO_4 \cdot 5\ H_2O$ has a mass of 1.235 g, but after heating to drive off all the water, the mass is only 0.822 g. What is the mass percent of $CuSO_4 \cdot 5\ H_2O$ in the mixture?
4.0 [ ] %

---

5. KT6 4.P.044. [489880] Show Details

To find the formula of a compound composed of iron and carbon monoxide, $Fe_x(CO)_y$, the compound is burned in pure oxygento give Fe_2O_3 and CO_2. If you burn 1.959 g of $Fe_x(CO)_y$ and obtain 0.799 g of Fe_2O_3 and 2.200 g of CO_2, what is the empirical formula of $Fe_x(CO)_y$? (Type your answer using the format CO2 for CO_2.)
[ ]

---

6. KT6 4.P.045. [467603] Show Details

Balance the following equations. (Use the lowest possible coefficients.)

(a) the synthesis of urea, a common fertilizer
[ ] $CO_2(g)$ + [ ] $NH_3(g) \rightarrow$ [ ] $CO(NH_2)_2(s)$ + [ ] $H_2O(l)$
(b) reactions used to make uranium(VI) fluoride for the enrichment of natural uranium
[ ] $UO_2(s)$ + [ ] $HF(aq) \rightarrow$ [ ] $UF_4(s)$ + [ ] $H_2O(l)$
[ ] $UF_4(s)$ + [ ] $F_2(g) \rightarrow$ [ ] $UF_6(s)$
(c) The reaction to make titanium(IV) chloride, which is then converted to titanium metal.
[ ] $TiO_2(s)$ + [ ] $Cl_2(g)$ + [ ] $C(s) \rightarrow$ [ ] $TiCl_4(l)$ + [ ] $CO(g)$
[ ] $TiCl_4(l)$ + [ ] $Mg(s) \rightarrow$ [ ] $Ti(s)$ + [ ] $MgCl_2(s)$

---

7. KT6 4.P.050. [489843] Show Details

Your body deals with excess nitrogen by excreting it in the form of urea, NH_2CONH_2.The reaction producing it is the combination of arginine ($C_6H_{14}N_4O_2$) with water to give urea and ornithine ($C_5H_{12}N_2O_2$).

$C_6H_{14}N_4O_2 + H_2O \rightarrow NH_2CONH_2 + C_5H_{12}N_2O_2$

If you excrete 65 mg of urea, what quantity of arginine must have been used?
4.0 [ ] g
What mass of ornithine must have been produced?
4.0 [ ] g

---

8. KT6 4.P.068. [486058] Show Details

Thioridazine, $C_{21}H_{26}N_2S_2$, is a pharmaceutical used to regulate dopamine. (Dopamine, a neurotransmitter, affects brain processes that control movement, emotional response, and ability to experience pleasure and pain.) A chemist can analyze a sample of the pharmaceutical for the thioridazine content by decomposing it to convert the sulfur in the compound to sulfate ion. This is then "trapped" as water-insoluble barium sulfate (see Figure 4.8).

$$SO_4^{2-}(aq, \text{ from thioridazine}) + BaCl_2 \rightarrow BaSO_4(s) + 2\ Cl^-(aq)$$

Figure 4.8

Suppose a 6 tablet sample of the drug yielded 0.397 g of $BaSO_4$. What is the thioridazine content, in milligrams, of each tablet?

4.0 ☑ _____ mg

---

9. KT6 4.P.014. [486064] Show Details

The formation of water-insoluble silver chloride is useful in the analysis of chloride-containing substances. Consider the following unbalanced equation.

$$BaCl_2(aq) + AgNO_3(aq) \rightarrow AgCl(s) + Ba(NO_3)_2(aq)$$

(a) Balance the equation. (Use the lowest possible coefficients.)

_____ $BaCl_2(aq)$ + _____ $AgNO_3(aq)$ → _____ $AgCl(s)$ + _____ $Ba(NO_3)_2(aq)$

(b) What mass $AgNO_3$, in grams, is required for complete reaction with 0.142 g of $BaCl_2$?

4.0 ☑ _____ g

What mass of AgCl is produced?

4.0 ☑ _____ g

---

10. KT6 4.P.036. [486059] Show Details

The aluminum in a 0.750 g sample of an unknown material was precipitated as aluminum hydroxide, $Al(OH)_3$, which was then converted to Al_2O_3 by heating strongly. If 0.154 g of Al_2O_3 is obtained from the 0.750 g sample, what is the mass percent of aluminum in the sample?

4.0 ☑ _____ %

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Chapter 5 (397926)

About this Assignment

Description
Reactions in Aqueous Solutions

Instructions
Reactions in Aqueous Solutions

1. KT6 5.P.003. [489832] Show Details

Which compound or compounds in each of the following groups is (are) expected to be soluble in water? (Select all that apply.)

(a)
- ☐ $PbCO_3$
- ☐ $PbSO_4$
- ☐ $Pb(NO_3)_2$

(b)
- ☐ $NaCH_3CO_2$
- ☐ $NaClO_4$
- ☐ Na_2SO_4

(c)
- ☐ AgBr
- ☐ KBr
- ☐ Al_2Br_6

2. KT6 5.P.011. [467604] Show Details

Predict the products of each precipitation reaction, and then balance the completed equation. (Type your answers using the format CH4 for CH_4. Use the lowest possible coefficients.)

(a) [ ] $Mn(NO_3)_2(aq)$ + [ ] $Na_3PO_4(aq)$ → [ ] [ ] (s) + [ ] [ ] (aq)

(b) [ ] $NiCl_2(aq)$ + [ ] $(NH_4)_2S(aq)$ → [ ] [ ] (s) + [ ] [ ] (aq)

3. KT6 5.P.013. [467443] Show Details

Write a balanced equation for the ionization of nitric acid in water. (Type your answer using the format [PO4]3- for PO_4^{3-}. Use the lowest possible coefficients.)

[ ] [ ] (aq) + [ ] [ ] (l) → [ ] [ ] (aq) + [ ] $NO_3^-(aq)$

4. KT6 5.P.014. [489846] Show Details

Write a balanced equation for the ionization of perchloric acid in water. (Type your answer using the format [CO3]2- for CO_3^{2-}. Use the lowest possible coefficients.)

[ ] [ ] (*aq*) → [ ] H^+(*aq*) + [ ] [ ] (*aq*)

---

5. KT6 5.P.020. [489863] Show Details

Complete and balance the following acid-base reactions. Name the reactants and products. (Type your answer using the format CO2 for CO_2. Use the lowest possible coefficients.)

(a) [ ] H_3PO_4(aq) + [ ] KOH(aq) → [ ] [ ] (aq) + [ ] [ ] (*l*)

reactants in order from left to right

[ ]
[ ]

products in order from left to right

[ ]
[ ]
[ ]

(b) [ ] $H_2C_2O_4$(*aq*) + [ ] $Ca(OH)_2$(*s*) → [ ] [ ] (*s*) + [ ] [ ] (*l*)

($H_2C_2O_4$ is oxalic acid, an acid capable of donating two H^+ ions.)

reactants in order from left to right

[ ]
[ ]

products in order from left to right

[ ]
[ ]
[ ]

---

6. KT6 5.P.028. [489875] Show Details

The beautiful red mineral rhodochrosite is manganese(II) carbonate. Write an overall balanced equation for the reaction of the mineral with nitric acid. Name each reactant and product. (Type your answer using the format CH4 for CH_4. Use the lowest possible coefficients.)

[ ] [ ] (*s*) + [ ] [ ] (*aq*) → [ ] [ ] (*aq*) + [ ] [ ] (*g*) + [ ] [ ] (*l*)

reactants in order from left to right

[ ]
[ ]

products in order from left to right

[ ]
[ ]
[ ]

---

7. KT6 5.P.029. [467341] Show Details

Balance the following reactions and then classify each one as a precipitation, acid-base reaction, or gas-forming reaction.

(a) [ ] $Ba(OH)_2$(*s*) + [ ] HCl(*aq*) → [ ] $BaCl_2$(*aq*) + [ ] H_2O(*l*)

- ○ precipitation
- ○ acid-base
- ○ gas-forming

(b) [ ] HNO_3(*aq*) + [ ] $CoCO_3$(*s*) → [ ] $Co(NO_3)_2$(*aq*) + [ ] H_2O(*l*) + [ ] CO_2(*g*)

- ○ precipitation
- ○ acid-base
- ○ gas-forming

(c) [ ] Na_3PO_4(*aq*) + [ ] $Cu(NO_3)_2$(*aq*) → [ ] $Cu_3(PO_4)_2$(*s*) + [ ] $NaNO_3$(*aq*)

- ○ precipitation
- ○ acid-base

gas-forming

8. KT6 5.P.035. [467192] Show Details

Determine the oxidation number of each element in the following ions or compounds.

(a) BrO_3^-
Br
O

(b) $C_2O_4^{2-}$
C
O

(c) F_2
F

(d) CaH_2
Ca
H

(e) H_4SiO_4
H
Si
O

(f) SO_4^{2-}
S
O

9. KT6 5.P.039. [467577] Show Details

In the following reactions, decide which reactant is oxidized and which is reduced. Designate the oxidizing agent and reducing agent. (Type your answer using the format CH4 for CH_4.)

(a) $C_2H_4(g) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 2\ H_2O(g)$
oxidized
reduced
oxidizing agent
reducing agent

(b) $Si(s) + 2\ Cl_2(g) \rightarrow SiCl_4(l)$
oxidized
reduced
oxidizing agent
reducing agent

10. KT6 5.P.042. [486476] Show Details

Some potassium dichromate ($K_2Cr_2O_7$), 2.325 g, is dissolved in enough water to make exactly 490. mL of solution. What is the molar concentration of the potassium dichromate?

4.0 *M*

What are the molar concentrations of the K^+ and $Cr_2O_7^{2-}$ ions?

K^+

4.0 ☑ _____ *M*

$Cr_2O_7^{2-}$

4.0 ☑ _____ *M*

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Chapter 6 (397928)

About this Assignment

Description
Principles of Reactivity: Energy and Chemical Reactions

Instructions
Principles of Reactivity: Energy and Chemical Reactions

1. KT6 6.P.020. [489840] Show Details

The heat energy required to melt 1.00 g of ice at 0°C is 333 J. If one ice cube has a mass of 57.0 g, and a tray contains 16 ice cubes, what quantity of energy is required to melt a tray of ice cubes to form liquid water at 0℃?

4.0 [ ] J

---

2. KT6 6.P.018. [489879] Show Details

A 237 g piece of molybdenum, initially at 100.0℃, i s dropped into 244 g of water at 10.0℃. When the system comes to thermal equilibrium, the temperature is 15.3℃. What is the specific heat capacity of molybdenum?

4.0 [ ] J/g ▪ K

---

3. KT6 6.P.028. [467506] Show Details

Calcium carbide, CaC_2, is manufactured by the reaction of CaO with carbon at a high temperature. (Calcium carbide is then used to make acetylene.)

$$CaO(s) + 3\ C(s) \rightarrow CaC_2(s) + CO(g)\ \Delta H°_{rxn} = -464.8\ kJ$$

Is this reaction endothermic or exothermic?

- ○ exothermic
- ○ endothermic

If 19.7 g of CaO is allowed to react with an excess of carbon, what quantity of heat is absorbed or evolved by the reaction?

4.0 [ ] kJ

---

4. KT6 6.P.032. [467265] Show Details

You mix 125 mL of 0.250 *M* CsOH with 50.0 mL of 0.625 *M* HF in a coffee-cup calorimeter, and the temperature of both solutions rises from 21.50℃ before mixing to 24.40℃ after the reaction.

$$CsOH(aq) + HF(aq) \rightarrow CsF(aq) + H_2O(l)$$

What is the enthalpy of reaction per mole of CsOH? Assume the densities of the solutions are all 1.00 g/mL and the specific heats of the solutions are 4.2 J/g ▪ K.

4.0 [ ] kJ/mol

---

5. KT6 6.P.037. [467588] Show Details

Sulfur (1.81 g) is burned in a constant volume calorimeter with excess O_2(g). The temperature increases from 21.25℃ to 25.13℃. The bomb has a heat capacity of 923 J/K, and the cal orimeter contains 815 g of

water. Calculate the heat evolved, per mole of SO_2 formed, for the reaction

$$S_8(s) + 8\ O_2(g) \rightarrow 8\ SO_2(g)$$

4.0 ☑ [ ] kJ/mol

Sulfur burns in oxygen, with a bright blue flame, to give sulfur dioxide gas, SO_2. (*C.D. Winters*)

---

6. KT6 6.P.039. [467575] Show Details

Suppose you burn 1.558 g of benzoic acid, $C_6H_5CO_2H$, in a constant volume calorimeter and find that the temperature increases from 22.50℃ to 31.85℃. The calorimeter contains 775 g of water, and the b omb has a heat capacity of 893 J/K. What quantity of heat is evolved in this combustion reaction, per mole of benzoic acid?

4.0 ☑ [ ] kJ/mol

---

7. KT6 6.P.041. [467216] Show Details

An "ice calorimeter" can be used to determine the specific heat of a metal. A piece of hot metal is dropped into a weighed quantity of ice. The quantity of heat transferred from the metal to the ice can be determined from the amount of ice melted. Suppose you heat a 40.0 g piece of metal to 99.8℃ and then drop it onto ice . When the metal's temperature has dropped to 0.0℃, it is found that 7.03 g of ice has melted. What is the specific heat capacity of silver?

4.0 ☑ [ ] J/g ▪ K

---

8. KT6 6.P.046. [467149] Show Details

You wish to know the enthalpy change for the formation of liquid PCl_3 from the elements shown below.

$$P_4(s) + 6\ Cl_2(g) \rightarrow 4\ PCl_3(l)\ \Delta H°_f = ?$$

The enthalpy change for the formation of PCl_5 from the elements can be determined experimentally, as can the enthalpy change for the reaction of $PCl_3(l)$ with more chlorine to give $PCl_5(s)$.

$$P_4(s) + 10\ Cl_2(g) \rightarrow 4\ PCl_5(s)\ \Delta H°_{rxn} = -1774.0\ kJ$$

$$PCl_3(l) + Cl_2(g) \rightarrow PCl_5(s)\ \Delta H°_{rxn} = -123.8\ kJ$$

Use these data to calculate the enthalpy change for the formation of 1.80 mol of $PCl_3(l)$ from phosphorus and chlorine.

4.0 ☑ [ ] kJ

---

9. KT6 6.P.054. [467461] Show Details

The Romans used calcium oxide, CaO, to produce a strong mortar. The CaO was mixed with water to give $Ca(OH)_2$, which reacted slowly with CO_2 in the air to give $CaCO_3$.

$$Ca(OH)_2(s) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(g)$$

(a) Calculate the standard enthalpy change for this reaction.

[ ] kJ

(b) What quantity of heat is evolved or absorbed if 1.40 kg of $Ca(OH)_2$ reacts with a stoichiometric amount of CO_2?

4.0 ☑ [ ] kJ

---

10. KT6 6.P.107. [467354] Show Details

You want to heat the air in your house with natural gas (CH_4). Assume your house has 241 m^2 (about 2453 ft^2) of floor area and that the ceilings are 2.20 m from the floors. The air in the house has a molar heat capacity of 29.1 J/mol ▪ K. (The number of moles of air in the house can be found by assuming that the average molar mass of air is 28.9 g/mol and that the density of air at these temperatures is 1.22 g/L.) What mass of methane do you have to burn to heat the air from 17.5℃ to 22.0℃?

4.0 ☑ [ ] g

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Chapter 7 (397929)

About this Assignment

Description
Atomic Structure

Instructions
Atomic Structure

1. KT6 7.P.005. [489845] Show Details

Green light has a wavelength of 5.1 × 10^2 nm.
What is the energy, in joules, of one photon of green light?
4.0 ☑ _____ J/photon
What is the energy, in joules, of 1.0 mol of photons of green light?
4.0 ☑ _____ J/mol

---

2. KT6 7.P.006. [467162] Show Details

Violet light has a wavelength of about 409 nm. What is its frequency?
4.0 ☑ _____ s^{-1}
Calculate the energy of one photon of violet light.
4.0 ☑ _____ J
What is the energy of 1.1 mol of violet photons?
4.0 ☑ _____ kJ
Compare the energy of photons of violet light with those of red light. Which is more energetic?
- ○ violet light
- ○ red light

---

3. KT6 7.P.012. [467500] Show Details

You are an engineer a switch that works by the photoelectric effect. The metal you wish to use in your device requires 6.7× 10^{-19} J/atom to remove an electron. Will the switch work if the light falling on the metal has a wavelength of 540 nm or greater?
- ○ yes
- ○ no

Why or why not?
- ○ The device will work because wavelengths less than 540 nm cannot be used for device operation.
- ○ The device will not work because the atmosphere will filter out wavelengths less than 540 nm.
- ○ The device will work because wavelengths greater than 540 nm can operate the device.

---

4. KT6 7.P.013. [467352] Show Details

The most prominent line in the spectrum of mercury is at 253.652 nm. Other lines are located at 365.015 nm, 404.656 nm, 435.833 nm, and 1013.975 nm.

(a) Which of these lines represents the most energetic light?
- ○ 253.652 nm
- ○ 365.015 nm
- ○ 404.656 nm

- ○ 435.833 nm
- ○ 1013.975 nm

(b) What is the frequency of the most prominent line?

[ ] s^{-1}

What is the energy of one photon with this wavelength?

[ ] J/photon

(c) Are any of these lines found in the spectrum of mercury shown in Figure 7.9?

- ○ yes
- ○ no

Which ones?

- ☐ 253.652 nm
- ☐ 365.015 nm
- ☐ 404.656 nm
- ☐ 435.833 nm
- ☐ 1013.975 nm
- ☐ None of these.

What color or colors are these lines?

- ☐ violet
- ☐ blue
- ☐ red
- ☐ orange
- ☐ yellow
- ☐ green
- ☐ None of these.

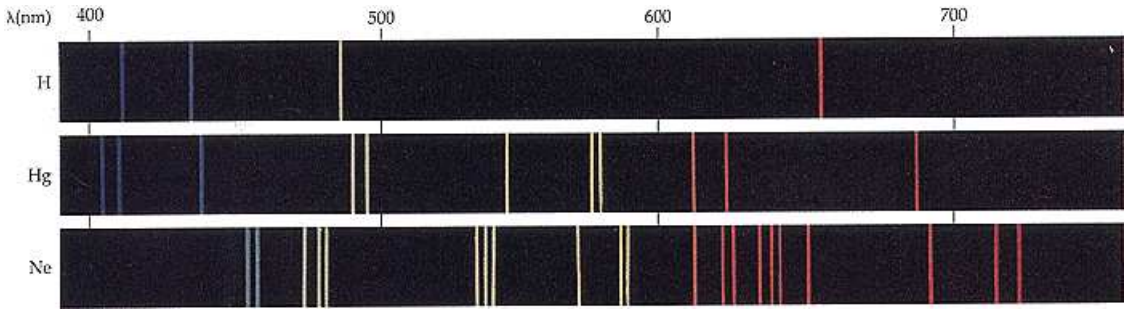

Figure 7.9

---

5. KT6 7.P.017. [467332] Show Details

Consider only transitions involving the following energy levels for the hydrogen atom (where the energy level spacing below are not to scale).

_____ $n = 5$

_____ $n = 4$

_____ $n = 3$

_____ $n = 2$

_____ $n = 1$

(a) How many emission lines are possible, considering only these five quantum levels?

[ ] lines

(b) Photons of the highest frequency are emitted in a transition from the level with $n =$ [ ] to a

level with the n = [ ].

(c) The emission line having the longest wavelength corresponds to a transition from the level with n = [ ] to a level with the n = [ ].

---

6. KT6 7.P.019. [467435] Show Details

The energy emitted when an electron moves from a higher energy state to a lower energy state in any atom can be observed as electromagnetic radiation.

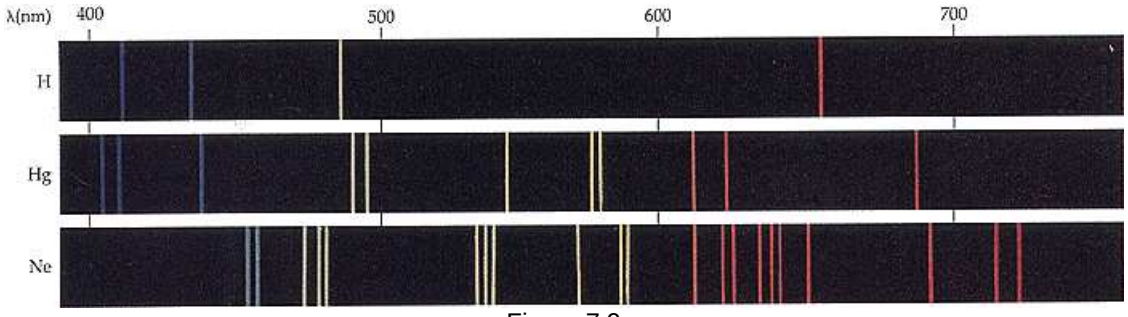

Figure 7.9

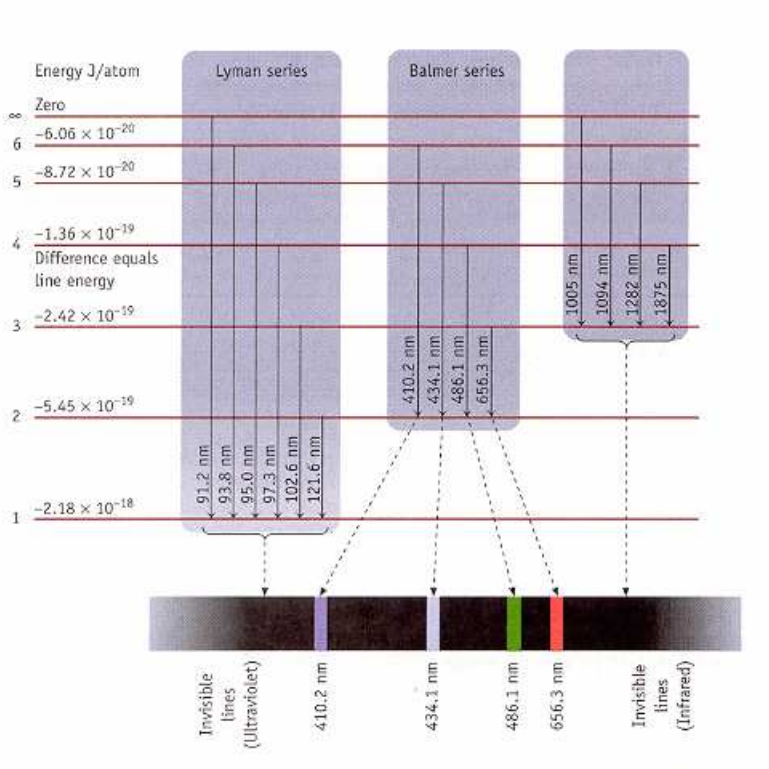

Figure 7.12

(a) Which involves the emission of less energy in the H atom, an electron moving from n = 4 to n = 2 or an electron moving from n = 3 to n = 2?

- Both emit the same energy.
- n = 3 to n = 2
- n = 4 to n = 2
- Energy is never emitted.

(b) Which involves the emission of more energy in the H atom, an electron moving from n = 4 to n = 1 or an electron changing from n = 5 to n = 2? Explain.

- n = 5 to n = 2, because the energy level are progressively widening at higher levels.
- Both these jumps are not associated with energy emission.

- Both have the same energy level as the jump is three orbits.
- n = 4 to n = 1, because the energy levels are progressively closer at higher levels.

---

7. KT6 7.P.025. [467434] Show Details

Calculate the wavelength, in nanometers, associated with a 1.3×10^{2} g golf ball moving at 30. m/s (about 67 mph).

4.0 ☑ _____ nm

How fast must the ball travel to have a wavelength of 4.5×10^{-3} nm?

4.0 ☑ _____ m/s

---

8. KT6 7.P.028. [489799] Show Details

Answer the following questions.

(a) When n = 4, ℓ = 2, and m_ℓ = -1, to what orbital type does this refer? (Type the orbital label using the format 1s for 1*s*.)

_____

(b) How many orbitals occur in the n = 3 electron shell?

_____

How many subshells?

_____

What are the letter labels of the subshells?

- *s*
- *s*, *p*
- *s*, *p*, *d*
- *s*, *p*, *d*, *f*
- *s*, *p*, *d*, *f*, *g*

(c) If a subshell is labeled *f*, how many orbitals occur in the subshell?

_____

What are the values of m_ℓ?

- 0
- 0, ±1
- 0, ±1, ±2
- 0, ±1, ±2, ±3

---

9. KT6 7.P.035. [489872] Show Details

What is the maximum number of orbitals that can be identified by each of the following sets of quantum numbers? (0 is a possible answer.)

(a) n = 7, ℓ = 5

_____

(b) n = 2, ℓ = 1, m_ℓ = +3

_____

(c) n = 4, ℓ = 2

_____

(d) n = 6, ℓ = 3, m_ℓ = 0

_____

---

10. KT6 7.P.054. [489811] Show Details

Radiation in the ultraviolet region of the electromagnetic spectrum is quite energetic. It is this radiation that causes dyes to fade and your skin to burn. If you are bombarded with 1.00 mol of photons with a wavelength of 284 nm, what amount of energy, in kilojoules per mole of photons, are you being subjected to?

4.0 kJ/mol

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Chapter 8 (397932)

About this Assignment

Description
Atomic Electron Configurations and Chemical Periodicity

Instructions
Atomic Electron Configurations and Chemical Periodicity

1. KT6 8.P.001. [467290] Show Details

Write the electron configurations for Cl and Al using the *spdf* notation. (Type your answer using the format 1s2 2s2 for $1s^2 2s^2$.)

Cl

Al

Write the electron configurations for Cl and Al using orbital box diagrams. (Enter your answer using UP to indicate an upwards pointing arrow, DOWN to indicate a downwards pointing arrow, UP/DOWN to indicate two arrows, and BLANK to indicate no arrows.)

Cl

1*s* 2*s* 2*p* 3*s* 3*p*

Al

1*s* 2*s* 2*p* 3*s* 3*p*

Describe the relationship between each atom's electron configuration and its position in the periodic table.

2. KT6 8.P.003. [467299] Show Details

Using the *spdf* notation, write the electron configurations for atoms of chromium and iron, two of the major components of stainless steel. (Type your answer using the format 1s2 2s2 for $1s^2 2s^2$.)

Cr

Fe

3. KT6 8.P.006. [489792] Show Details

Using the spectroscopic and noble gas notations, write electron configurations for atoms of the following elements and then check your answers with Table 8.3. (Type your answer using the format [Ar] 4s2 3d10 4p2 for [Ar] $4s^2\ 3d^{10}\ 4p^2$.)

(a) Mercury, Hg

(b) Zirconium, Zr

(c) Sodium, Na

(d) Platinum, Pt

4. KT6 8.P.007. [467560] Show Details

Use noble gas and *spdf* notations to predict electron configurations for the following metals of the third transition series. (Type your answer using the format [Ar] 4s2 3d10 4p2 for [Ar] $4s^2\ 3d^{10}\ 4p^2$. If the configuration is a noble gas, enter the noble gas in brackets, for example [Ne] for F^-.)

(a) Tantalum, Ta. The metal and its alloys resist corrosion and are often used in surgical and dental tools.

(b) Platinum, Pt. This metal was used by pre-Columbian Indians in jewelry. It is used now in jewelry and for anticancer drugs and industrial catalysts.

5. KT6 8.P.026. [467507] Show Details

Arrange the following elements in order of increasing size: Br, Tl, Cl, As, and Pb. (Try doing it without looking at Figure 8.11, then check yourself by looking up the necessary atomic radii.)

< < < <

6. KT6 8.P.031. [467569] Show Details

Compare the elements Na, Mg, O, and P.

(a) Which has the largest atomic radius?

(b) Which has the most negative electron affinity?

(c) Place the elements in order of increasing ionization energy.

---Select--- < ---Select--- < ---Select--- < ---Select---

7. KT6 8.P.047. [467233] Show Details

Answer the questions below about the elements A and B, which have the electron configurations shown.

element A = $[Kr]5s^1$

element B = $[Ar]3d^{10}4s^24p^4$

(a) What is element A?

- metalloid
- metal
- nonmetal

(b) Which element has the greater ionization energy?

- element A

- element B

(c) Which element has the less negative electron affinity?

- element A
- element B

(d) Which element has the larger atomic radius?

- element A
- element B

---

8. KT6 8.P.050. [467556] Show Details

Place the following elements and ions in order of decreasing size: K^+, Cl^-, S^{2-}, and Ca^{2+}.

---Select--- > ---Select--- > ---Select--- > ---Select---

---

9. KT6 8.P.052. [467430] Show Details

The following are isoelectronic species.

$$Cl^-, K^+, Ca^{2+}$$

(a) Rank them in order of increasing size.

- $K^+ < Cl^- < Ca^{2+}$
- $Cl^- < Ca^{2+} < K^+$
- $Ca^{2+} < K^+ < Cl^-$

(b) Rank them in order of increasing ionization energy.

- $K^+ < Ca^{2+} < Cl^-$
- $Ca^{2+} < K^+ < Cl^-$
- $Cl^- < K^+ < Ca^{2+}$

(c) Rank them in order of increasing electron affinity.

- $Cl^- < K^+ < Ca^{2+}$
- $Ca^{2+} < K^+ < Cl^-$
- $K^+ < Ca^{2+} < Cl^-$

---

10. KT6 8.P.058. [489827] Show Details

Which ions in the following list are not likely to be found in chemical compounds: Al^{4+}, Se^{2-}, B^{4+}, Mg^{2+}, and Li^{2+}?

- B^{4+}
- Li^{2+}
- Se^{2-}
- Al^{4+}
- Mg^{2+}

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Chapter 9 (397934)

About this Assignment

Description
Bonding and Molecular Structure: Fundamental Concepts

Instructions
Bonding and Molecular Structure: Fundamental Concepts

1. KT6 9.P.007. [467486] Show Details

List the following compounds in order of increasing lattice energy (from least negative to most negative): LiI, LiF, CaO, RbI.
---Select--- < ---Select--- < ---Select--- < ---Select---

2. KT6 9.P.012. [467357] Show Details

Draw a Lewis structure for each of the following molecules or ions. (Do this on paper. Your instructor may ask you to turn in this work.)

(a) CS_2
(b) BF_4^-
(c) NO_2^-
(d) $SOCl_2$

3. KT6 9.P.020. [467414] Show Details

Draw a Lewis structure for each of the following molecules or ions. (Do this on paper. Your instructor may ask you to turn in this work.)

(a) NH_2Cl
(b) Cl_2O (O is the central atom)
(c) HOF
(d) CS_2

Describe the electron-pair geometry and the molecular geometry around the central atom.

(a) NH_2Cl

electron pair geometry
- bent
- linear
- tetrahedral
- trigonal planar

molecular geometry
- bent
- linear
- tetrahedral
- trigonal planar
- trigonal pyramidal

(b) Cl_2O (O is the central atom)

electron pair geometry
- bent
- linear
- tetrahedral
- trigonal planar

molecular geometry
- bent
- linear
- tetrahedral
- trigonal planar
- trigonal pyramidal

(c) HOF

electron pair geometry
- bent
- linear
- tetrahedral
- trigonal planar

molecular geometry
- bent

(d) CS_2

electron pair geometry
- bent
- linear
- tetrahedral
- trigonal planar

molecular geometry
- bent

- linear
- tetrahedral
- trigonal planar
- trigonal pyramidal

- linear
- tetrahedral
- trigonal planar
- trigonal pyramidal

4. KT6 9.P.024. [467317] Show Details

Draw a Lewis structure of each of the following molecules or ions. (Do this on paper. Your instructor may ask you to turn in this work.)

(a) XeF_4
(b) ClF_2^-
(c) PF_5
(d) SF_4

Describe the electron-pair geometry and molecular geometry around the central atom.

(a) XeF_4

electron pair geometry
- octahedral
- trigonal bipyramidal
- tetrahedral

molecular geometry
- linear
- octahedral
- see-saw
- square planar
- square pyramidal
- trigonal bipyramidal
- T-shaped
- tetrahedral

(b) ClF_2^-

electron pair geometry
- octahedral
- trigonal bipyramidal
- tetrahedral

molecular geometry
- linear
- octahedral
- see-saw
- square planar
- square pyramidal
- trigonal bipyramidal
- T-shaped
- tetrahedral

(c) PF_5

electron pair geometry
- octahedral
- trigonal bipyramidal
- tetrahedral

molecular geometry
- linear
- octahedral
- see-saw
- square planar
- square pyramidal
- trigonal bipyramidal
- T-shaped
- tetrahedral

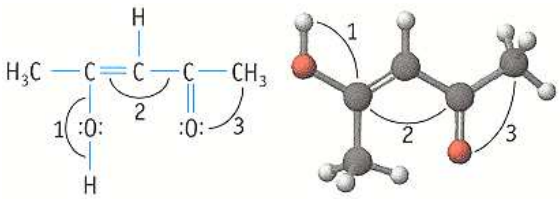
(d) SF_4

electron pair geometry
- octahedral
- trigonal bipyramidal
- tetrahedral

molecular geometry
- linear
- octahedral
- see-saw
- square planar
- square pyramidal
- trigonal bipyramidal
- T-shaped
- tetrahedral

5. KT6 9.P.028. [489790] Show Details

Acetylacetone has the structure shown here. Estimate the values of the indicated angles.



angle 1 ---Select--- angle 2 ---Select--- angle 3 ---Select---

6. KT6 9.P.030. [489813] Show Details

Determine the formal charge on each atom in each of the following molecules or ions.

(a) CO_2
C
O
O

(b) HCO_2^- (formate ion)
H
C
O (attached by a double bond)
O

(c) N_2O
N
N (central atom)
O

(d) HNO_3 (nitric acid)
H
N
O (attached by a double bond)
O
O (attached to a hydrogen)

7. KT6 9.P.033. [467244] Show Details

For each pair of bonds, indicate the more polar bond.

(a) C-O and C-N
- CO
- CN

(b) P-Br and P-Cl
- PBr
- PCl

(c) B-O and B-S
- BS
- BO

(d) B-F and B-I
- BI
- BF

8. KT6 9.P.037. [467464] Show Details

Considering both formal charges and bond polarities, predict on which atom or atoms the negative charge resides in the following anions. (Type your answer using the element's atomic symbol.)

(a) BH_4^-
(atoms)

(b) BF_4^-
(atoms)

(c) $CH_3CO_2^-$
(atoms)

(d) OH^-
(atoms)

9. KT6 9.P.039. [467254] Show Details

Three resonance structures are possible for dinitrogen oxide, N_2O.

a **b** **c**

N-N≡O ↔ N=N=O ↔ N≡N-O

(a) Draw the three resonance structures. (Do this on paper. Your instructor may ask you to turn in this work.)

(b) Calculate the formal charge on each atom in each resonance structure.
structure a
left N

middle N
O
structure b
left N
middle N
O
structure c
left N
middle N
O

(c) Based on formal charges and electronegativity, predict which resonance structure is the most reasonable.
- structure a
- structure b
- structure c

10. KT6 9.P.048. [467576] Show Details

Give the number of bonds for each of the following molecules or ions. Give the bond order for each bond.

(a) CN^-
- one CN triple bond with bond order 3
- one CN double bond with bond order 2
- two CN single bonds with bond order 1

(b) CH_3CN
- three CH single bonds, one CC single bond, one CN triple bond with bond orders 1,1,3 respectively
- three CH triple bonds, one CC single bond, one CN triple bond with bond orders 3,1,1 respectively
- three CH single bonds, one CC double bond, one CN triple bond with bond orders 3,2,1 respectively

(c) SO_3
- three SO single bonds with bond order 1
- two SO single bonds, one SO triple bond with resonance structures and bond orders 1,1 respectively
- two SO single bonds, one SO double bond with resonance structures and bond orders 1,2 respectively

(d) $CH_3CH=CH_2$
- six CH single bonds, two CC single bonds with bond orders 1,1
- six CH single bonds, one CC single bond, one CC double bond with bond orders 1,1,2 respectively
- five CH single bonds, two CC single bonds, one CC double bond with bond orders 2,1,1 respectively

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Chapter 10 (397935)

About this Assignment

Description
Bonding and Molecular Structure: Orbital Hybridization and Molecular Orbitals

Instructions
Bonding and Molecular Structure: Orbital Hybridization and Molecular Orbitals

1. KT6 10.P.004. [467415] Show Details

Specify the electron-pair and molecular geometry for eachof the following. Describe the hybrid orbital set used by the underlined atom in each molecule or ion?

(a) $\underline{C}Se_2$
- sp
- sp^2
- sp^3
- sp^3d

(b) $\underline{S}O_2$
- sp
- sp^2
- sp^3
- sp^3d

(c) $\underline{C}H_2O$
- sp
- sp^2
- sp^3
- sp^3d

(d) $\underline{N}H_4^+$
- sp
- sp^2
- sp^3
- sp^3d

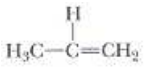
2. KT6 10.P.005. [467257] Show Details

Describe the hybrid orbital set used by each of the indicated atoms in the molecules listed below. (Type your answer using the format sp2 for sp^2.)

(a) left carbon atom in dimethyl ether, CH_3OCH_3

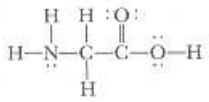
oxygen atom in dimethyl ether

(b) center carbon atom in propene



right carbon atom in propene

(c) nitrogen atom in the amino acid glycine

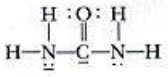


left carbon in glycine

3. KT6 10.P.006. [467285] Show Details

Give the hybrid orbital set used by each of the underlined atoms in the following molecules. (Type your answer using the format sp2 for sp^2.)

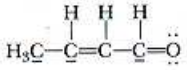
(a)



N

C

(b)

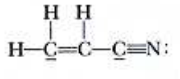


C of CH_3

C of C=C

C of C=O

(c)



C of C=C

C of C≡N

4. KT6 10.P.017. [467181] Show Details

Calcium carbide, CaC_2, contains the acetylide ion, C_2^{2-}.

(a) How many net σ and π bonds does the ion have?

σ =

π =

(b) What is the carbon-carbon bond order?

(c) How has the bond order changed on adding electrons to C_2 to obtain C_2^{2-}?

- yes
- no

(d) Is the C_2^{2-} ion paramagnetic?

- The bond order increases by one going from C_2 to C_2^-.
- The bond order decreases by one going from C_2 to C_2^-.

---

5. KT6 10.P.018. [489795] Show Details

Oxygen, O_2, can acquire one or two electrons to give O_2^- (superoxide ion) or O_2^{2-} (peroxide ion). Write the electron configuration for the ions in molecular orbital terms (Do this on paper. Your instructor may ask you to turn in this work.). Compare them with the O_2 molecule on the following bases.

	O_2	O_2^-	O_2^{2-}
(a) magnetic character	---Select---	---Select---	---Select---
(b) net number of π bonds			
(c) bond order			

(d) Which of the following has the shortest bond length. O_2, O_2^-, O_2^{2-}

- O_2
- O_2^-
- O_2^{2-}

---

6. KT6 10.P.020.Practice. [509749] Show Details

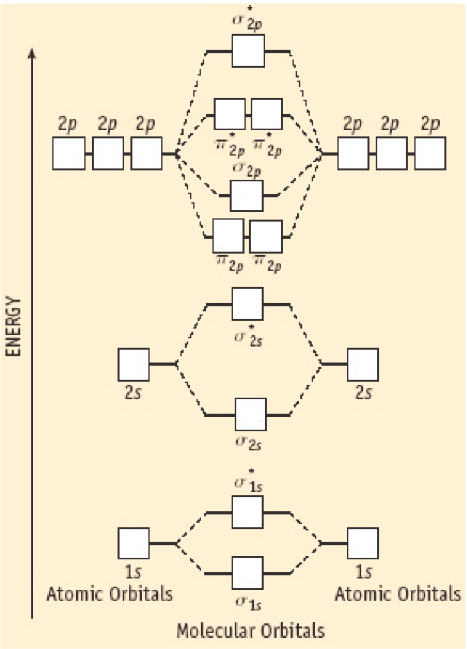
Answer all parts of the following question to receive credit.

Homework 10.20

MAIN QUESTION

Question 1 of 5

The nitrosyl ion, NO^+, has an interesting chemistry. Assume the diagram below applies to this structure. How many total electrons does NO^+ have?



Answer

Enter a response, then Submit.

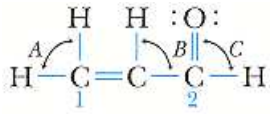
Submit

Question has not been submitted for scoring.

---

7. KT6 10.P.030. [489814] Show Details

Acrolein, a component of photochemical smog, has a pungent odor and irritates eyes and mucous membranes.



(a) What are the hybridizations of carbon atoms 1 and 2?

- sp^2
- sp^3d^2
- sp^3d
- sp^3

(b) What are the approximage values of angles A, B, and C?

angle A	angle B	angle C
109°	109°	109°
120°	120°	120°
180°	180°	180°

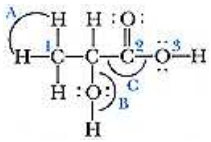
(c) Is *cis-trans* isomerism possible here?

- yes
- no

---

8. KT6 10.P.034. [467410] Show Details

Lactic acid is a natural compound found in sour milk.



(a) How many π bonds occur in lactic acid?

How many σ bonds bonds occur in lactic acid?

(b) Describe the hybridization of each atom 1 through 3.

C(1)
- sp^2
- sp^3
- sp^3d
- sp^3d^2

C(2)
- sp
- sp^2
- sp^3
- sp^3d

O(3)
- sp^2
- sp^3
- sp^3d
- sp^3d^2

(c) Which CO bond is the shortest in the molecule?
- C-O bond
- C=O

Which CO bond is the strongest in the molecule?
- C-O bond
- C=O

(d) What are the approximate values of the bond angles A, B, and C?

A=
B=
C=

---

9. KT6 10.P.044. [489818] Show Details

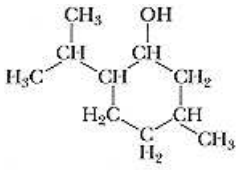
Which of the following molecules or molecule ions should be paramagnetic? What is the highest occupied molecular orbital (HOMO) in each one? Assume the molecular orbital diagram in Figure 10.22 applies to all of them. (Type your answer using the format sigma*2p for σ^*_{2p} or pi 2p for π_{2p}.)

molecule or ion	magnetic behavior	HOMO

(a) CN	---Select---	
(b) O_2^{2-}	---Select---	
(c) OF^-	---Select---	
(d) NO	---Select---	
(e) B_2	---Select---	

10. KT6 10.P.047. [467362] Show Details

Menthol is used in soaps, perfumes, and foods. It is present in the common herb mint, and it can be prepared from turpentine.



Model of menthol.

(a) What are the hybridizations used by the C atoms in the molecule?
- All of the C atoms are *sp* hybridized.
- All of the C atoms are sp^3 hybridized.
- Some of the C atoms are sp^2 hybridized and some are sp^3 hybridized.
- All of the C atoms are sp^2 hybridized.

(b) What is the approximate C-O-H bond angle?
- 60°
- 90°
- 109°
- 120°

(c) Is the molecule polar or nonpolar?
- nonpolar
- polar

(d) Is the six-member carbon ring planar or nonplanar?
- planar
- nonplanar

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Chapter 11 (397936)

About this Assignment

Description
Carbon: More than Just Another Element

Instructions
Carbon: More than Just Another Element

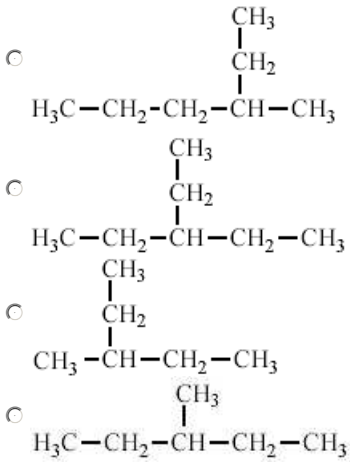
1. KT6 11.P.002. [467389] Show Details

What is the molecular formula for an alkane with 11 carbon atoms? (Type your answer using the format C2H4 for C_2H_4.)

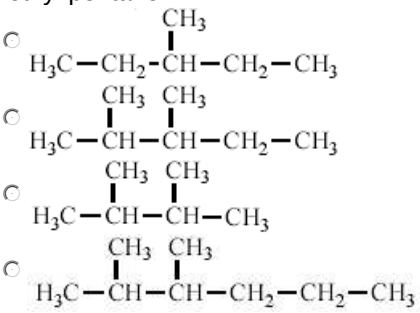
2. KT6 11.P.008. [489800] Show Details

Select structures for 3-ethylpentane and 2,3-dimethyl pentane.

3-ethylpentane



2,3-dimethyl pentane



3. KT6 11.P.026. [467451] Show Details

Give the systematic name for each of the following compounds.

(a)

(b)

(c)

---

4. KT6 11.P.032. [489791] Show Details

Select structural formulas for the following alcohols, and tell if each is primary, secondary or tertiary.

(a) 1-butanol

- $CH_3CH_2CH_2CH_3$
- $HO-CH_2CH_2CH_3$
- $HO-CH_2CH_2CH_2CH_3$
- $HO-CH_2CH_2CH_2CH_2CH_3$

- secondary
- primary
- tertiary

(b) 2-butanol

- $CH_3CH_2CH_2CH_3$
- $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_2CH_3$
- $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$
- $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_2CH_2CH_3$

- primary
- secondary
- tertiary

(c) 3,3-dimethyl-2-butanol

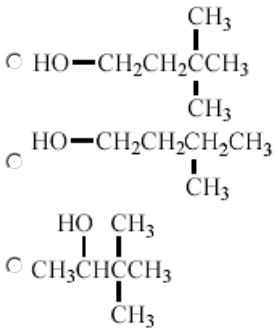
- $CH_3\underset{\displaystyle HO}{\underset{|}{C}}H\underset{\displaystyle CH_3}{\underset{|}{C}}CH_3$
- $CH_3\underset{\displaystyle HO}{\underset{|}{C}}H\underset{\displaystyle CH_3}{\underset{|}{C}}CH_3$ (with CH_2 on the upper carbon)
- $CH_3\underset{\displaystyle HO}{\underset{|}{C}}HCH_3$
- $HO-CH_2CH_2CH_2CH_3$

- primary
- secondary
- tertiary

(d) 3,3-dimethyl-1-butanol

- $CH_2CH_2\underset{\displaystyle CH_3}{\underset{|}{C}}CH_3$ (with CH_3 on the upper carbon)

- primary
- secondary
- tertiary



5. KT6 11.P.034. [467369] Show Details

Name the following amines.

(a) $CH_3CH_2CH_2NH_2$
- aminopropane
- 2-propylamine
- 2-aminopropane
- propylamine

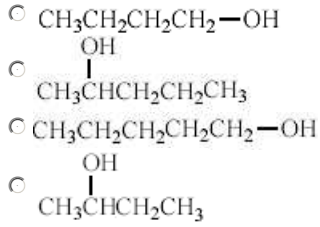
(b) $(CH_3)_3N$
- triaminomethane
- trimethylamine
- 1,3-aminomethane
- 3-methylamine

(c) $(CH_3)(C_2H_5)NH$
- 1,2-ethylmethylamine
- aminomethylethane
- 1,2-methylethylamine
- ethylmethylamine

6. KT6 11.P.038. [489803] Show Details

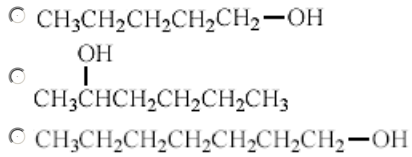
Aldehydes and carboxylic acids are formed by oxidation of primary alcohols, and ketones are formed when secondary alcohols are oxidized. Give the name and formula for the alcohol that, when oxidized gives the following products.

(a) $CH_3CH_2CH_2CHO$

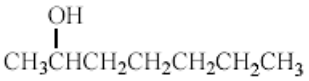


- 1-pentanol
- 2-butanol
- 2-pentanol
- 1-butanol

(b) 2-hexanone



- 2-hexanol
- 1-heptanol
- 1-hexanol
- 2-heptanol



7. KT6 11.P.040. [467450] Show Details

Identify the systematic names for each of the following compounds.

(a) 

- 2-propanal
- propanone
- propylene
- 2-propylene

(b) 

- 2-butane
- butanal
- butylamine
- butene

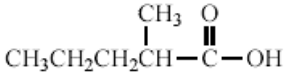
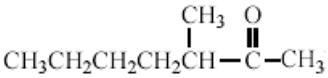
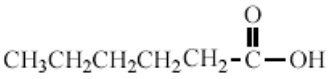
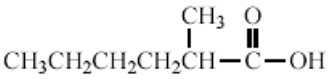
(c) 

- 2-pentamine
- 2-pentanone
- 1,2-pentanone
- pentene

8. KT6 11.P.042. [489798] Show Details

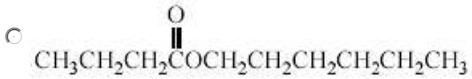
Select structural formulas for the following acids and esters.

(a) 2-methylhexanoic acid

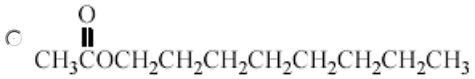
- 
- 
- 
- 

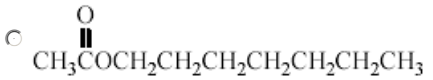
(b) pentyl butanoate (which has the odor of apricots)

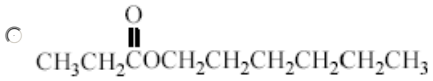
- 
- 



(c) octyl acetate (which has the odor of oranges)







9. KT6 11.P.095. [467344] Show Details

Write balanced equations for the combustion of ethane and ethanol. (Type your answer using the format CO2 for CO_2.)

ethane

C_2H_6 + [ ] [ ] → [ ] [ ] + [ ] H_2O

ethanol

C_2H_5OH + [ ] [ ] → [ ] [ ] + [ ] H_2O

(a)Calculate the heat of combustion for each compound.

ethane

[ ] kJ/g

ethanol

[ ] kJ/g

Which has the more negative enthalpy change for combustion per gram?

- ethane
- ethanol

(b)If ethanol is assumed to be partially oxidized ethane, what effect does this have on the heat of combustion?

10. KT6 11.P.014. [489789] Show Details

Give balanced equations for the following reactions of alkanes. (Use the lowest possible coefficients.)

(a) the reaction of methane with excess chlorine

[ ] $CH_4(g)$ + [ ] Cl_2 (g) → [ ] product 1(l) + [ ] product 2(g)

product 1

- CCl_4
- CCl_2
- CH_2
- CH_3

product 2

- CH_3
- Cl^-
- HCl
- H^+

(b) complete combustion of cyclohexane, C_6H_{12}, with excess oxygen

[ ] $C_6H_{12}(l)$ + [ ] $O_2(g)$ → [ ] product 1(g) + [ ] product 2(g)

product 1

- CO_2
- $C_6H_{11}^-$
- CO
- C_2H_4

product 2

- H_3O^+
- H^+
- H_2O
- HO^-

Submit for Testing

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Chapter 12 (397937)

About this Assignment

Description
Gases and their Properties

Instructions
Gases and their Properties

1. KT6 12.P.006. [467473] Show Details

A sample of CO_2 gas has a pressure of 47.1 mm Hg in a 125 mL flask. The sample is transferred to a new flask, where it has a pressure of 56.5 mm Hg at the same temperature. What is the volume of the new flask?

4.0 _____ mL

2. KT6 12.P.008. [467277] Show Details

A 5.4 mL sample of CO_2 gas is enclosed in a gas-tight syringe (see Figure 12.3) at 22℃. If the syringe is immersed in an ice bath (0℃), what is the new gas volu me, assuming that the pressure is held constant?

4.0 _____ mL

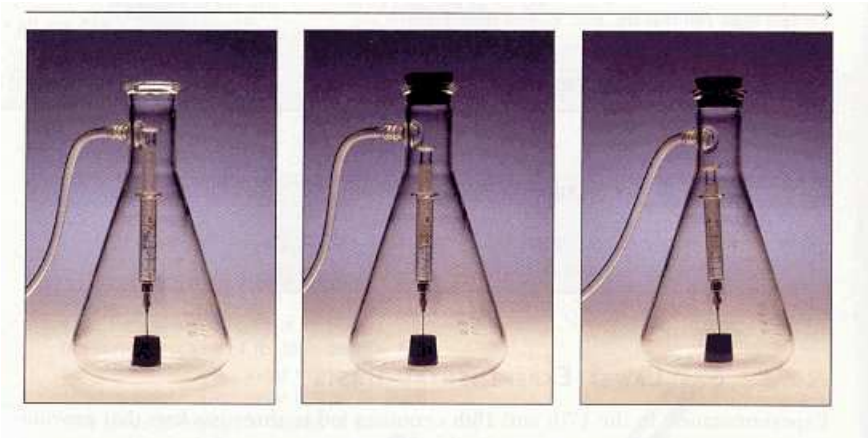

Figure 12.3

3. KT6 12.P.013. [467529] Show Details

One of the cylinders of an automobile engine has a volume of 400. cm^3. The engine takes in air at a pressure of 1.00 atm and a temperature of 15℃ and com presses the air to a volume of 45.4 cm^3 at 77℃. What is the final pressure of the gas in the cylinder? (The ratio of before and after volumes, in this case 400:50 or 8:1, is called the compression ratio.)

4.0 _____ atm

4. KT6 12.P.016. [467348] Show Details

Ethane, C_2H_6, burns in air according to the following equation.

$$2\ C_2H_6(g) + 7\ O_2(g) \rightarrow 4\ CO_2(g) + 6\ H_2O(g)$$

What volume of O_2 (in L) is required for complete reaction with 4.7 L of C_2H_6? Assume all gases are measured at the same temperature and pressure.

4.0 ☑ [ ] L

What volume of H_2O vapor (L) is produced?

4.0 ☑ [ ] L

---

5. KT6 12.P.024. [467241] Show Details

Diethyl ether, $(C_2H_5)_2O$, vaporizes easily at room temperature. If the vapor exerts a pressure of 215 mm Hg in a flask at 25℃, what is the density of the vapor?

4.0 ☑ [ ] g/L

---

6. KT6 12.P.030. [494976] Show Details

Acetaldehyde is a common liquid compound that vaporizes readily. Determine the molar mass of Acetaldehyde from the following data.

Sample mass = 0.107 g
Temperature = 0.0℃
Volume of gas = 125 mL
Pressure = 331 mm Hg

4.0 ☑ [ ] g/mol

---

7. KT6 12.P.032. [467182] Show Details

Silane, SiH_4, reacts with O_2 to give silicon dioxide and water.

$$SiH_4(g) + 2\ O_2(g) \rightarrow SiO_2(s) + 2\ H_2O(l)$$

A 6.40 L sample of SiH_4 gas at 356 mm Hg pressure and 25℃ is allowed to react with O_2 gas. What volume of O_2 gas, in liters, is required for complete reaction if the oxygen has a pressure of 236 mm Hg at 25℃?

4.0 ☑ [ ] L

---

8. KT6 12.P.034. [467309] Show Details

The hydrocarbon octane (C_8H_{18}) burns to give CO_2 and water vapor.

$$2\ C_8H_{18}(g) + 25\ O_2(g) \rightarrow 16\ CO_2(g) + 18\ H_2O(g)$$

If a 0.072 g sample of octane burns completely in O_2, what will be the pressure of water vapor in a 4.75 L flask at 30.0℃?

4.0 ☑ [ ] atm

If the O_2 gas needed for complete combustion was contained in a 4.75 L flask at 26.0℃, what would its pressure be?

4.0 ☑ [ ] atm

---

9. KT6 12.P.040. [467456] Show Details

A collapsed balloon is filled with He to a volume of 15 L at a pressure of 1.0 atm. Oxygen (O_2) is then added so that the final volume of the balloon is 24 L with a total pressure of 1.0 atm. The temperature, which remains constant throughout, is 20.℃.

(a) What mass of He does the balloon contain?

4.0 g

(b) What is the final partial pressure of He in the balloon?

4.0 atm

(c) What is the partial pressure of O_2 in the balloon?

4.0 atm

(d) What is the mole fraction of each gas?

χ_{helium}

4.0

χ_{oxygen}

4.0

10. KT6 12.P.050. [494973] Show Details

A sample of uranium fluoride is found to effuse at the rate of 17.7 mg/h. Under comparable conditions, gaseous I_2 effuses at the rate of 15.0 mg/h. What is the molar mass of the uranium fluoride? (*Hint*: Rates must be converted to units of moles per time.)

4.0 g/mol

11. KT6 12.P.063. [467578] Show Details

$Ni(CO)_4$ can be made by reacting finely divided nickel with gaseous CO. If you have CO in a 1.70 L flask at a pressure of 273 mm Hg at 25℃, along with 0.450 g of Ni powder, what is the theoretical yield of $Ni(CO)_4$?

4.0 g

12. KT6 12.P.102. [467462] Show Details

Each of the four tires of a car is filled with a different gas. Each tire has the same volume and each is filled to the same pressure, 3.0 atm, at 25℃. One tire contains 120. g of air, another tire has 79.0 g of neon, another tire has 16.1 g of helium, and the fourth tire has 151. g of an unknown gas.

(a) Do all four tires contain the same number of gas molecules? If not, which one has the greatest number of molecules?

- ○ tire with air
- ○ tire with neon
- ○ tire with helium
- ○ tire with unknown gas
- ○ all the same

(b) How many times heavier is a molecule of the unknown gas than an atom of helium?

×

(c) In which tire do the molecules have the largest kinetic energy?

- ○ tire with air
- ○ tire with neon
- ○ tire with helium
- ○ tire with unknown gas
- ○ all the same

In which tire do the molecules have the greatest average speed?

- ○ tire with air
- ○ tire with neon
- ○ tire with helium
- ○ tire with unknown gas
- ○ all the same

13. KT6 12.Tutor: Determining Molar Mass [510261] Show Details

Tutorial Question
If you have trouble answering the main question(s) below, a tutorial will guide you through the solution process.

Determining Molar Mass

MAIN QUESTION

Question

A gas sample is found to have the following properties:

mass:	2.36 g
volume:	514 mL
temperature:	28.3 °C
pressure:	724 mmHg

What is the molar mass of the gas, in g/mol?

Answer

Enter a response, then Submit.

_____ g/mol

Submit

APPROACH

Step 1
Convert volume to units of L.

Step 2
Convert temperature to K.

Step 3
Convert pressure to units of atm.

pressume (mmHg) • $\frac{1\text{ atm}}{760\text{ mmHg}}$ = pressure (atm)

Step 4
Calculate the amount of gas, in moles.

$n = \frac{PV}{RT}$ $R = 0.08206\ \text{L·atm/K·mol}$

Step 5
Calculate the molar mass.

molar mass = $\frac{\text{g sample}}{\text{mol sample}}$

Question has not been submitted for scoring.

---

14. KT6 12.P.070. [467335] Show Details

A miniature volcano can be made in the laboratory with ammonium dichromate. When ignited, it decomposes in a fiery display.

$$(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + 4\ H_2O(g) + Cr_2O_3(s)$$

If 0.86 g of ammonium dichromate is used, and if the gases from this reaction are trapped in a 20. L flask at 23℃, what is the total pressure of the gas in the flask?

4.0 _____ atm

What are the partial pressures of N_2 and H_2O?

N_2

4.0 _____ atm

H_2O

4.0 _____ atm

Submit for Testing