

Exceptions to the Octet Rule

Ck12 Science

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CHAPTER

1

Exceptions to the Octet Rule

- List the exceptions to the octet rule.

Department of the Treasury—Internal Revenue Service
Form 1040EZ **Income Tax Return for Single and Joint Filers With No Dependents** (99) **2011** OMB No. 1545-0044

Your first name and initial Last name Your social security number
 If a joint return, spouse's first name and initial Last name Spouse's social security number

Home address (number and street) If you have a P.O. box, see instructions Apt. no. Make sure the SSN(s) above are correct

City, town or post office, state, and ZIP code If you have a foreign address, also complete space below (see instructions) **Preferential Election Campaign** (Check box if you, or your spouse if filing jointly, want to file to the limit. Check to indicate if not using purchase method) Yes No

Foreign country name Foreign province/county Foreign postal code

Income
 1 Wages, salaries, and tips. This should be shown in box 1 of your Form(s) W-2. Attach your Form(s) W-2. 1
 2 Taxable interest. If the total is over \$1,500, you cannot use Form 1040EZ. 2
 3 Unemployment compensation and Alaska Permanent Fund dividends (see instructions). 3
 4 Add lines 1, 2, and 3. This is your **adjusted gross income**. 4
 5 If someone can claim you (or your spouse if a joint return) as a dependent, check the applicable box(es) below and enter the amount from the worksheet on back.
 You Spouse
 If no one can claim you (or your spouse if a joint return), enter \$9,500 if single; \$19,000 if married filing jointly. See back for explanation. 5
 6 Subtract line 5 from line 4. If line 5 is larger than line 4, enter 0. This is your **taxable income**. 6

Payments, Credits, and Tax
 7 Federal income tax withheld from Form(s) W-2 and 1099. 7
 8a Earned income credit (EIC) (see instructions). 8a
 b Nontaxable combat pay election. 8b
 9 Add lines 7 and 8a. These are your **total payments and credits**. 9
 10 Tax. Use the amount on line 6 above to find your tax in the tax table in the instructions. Then, enter the tax from the table on this line. 10

Refund
 11a If line 9 is larger than line 10, subtract line 10 from line 9. This is your **refund**. If Form 8888 is attached, check here 11a
 b Routing number e Type: Checking Savings
 d Account number

Amount You Owe
 12 If line 10 is larger than line 9, subtract line 9 from line 10. This is the **amount you owe**. For details, on how to pay, see instructions. 12

Third Party Designee
 Do you want to allow another person to discuss this return with the IRS (see instructions)? Yes, Complete below No
 Designee's name Phone no. Internal identification number (PIN)

Sign Here
 Under penalties of perjury, I declare that I have prepared this return and, to the best of my knowledge and belief, it is true, correct, and accurately reports all amounts and sources of income I received during the year. Declaration of preparer (other than the taxpayer) is based on all information of which the preparer has any knowledge.
 Your signature Date Your occupation Daytime phone number
 Spouse's signature (if a joint return, both must sign) Date Spouse's occupation If the IRS asks you an identity protection PIN, enter it here (see instructions)

Paid Preparer Use Only
 Print/type preparer's name Preparer's signature Date Check Preparer's PIN (see instructions)
 Firm's name Firm's EIN
 Firm's address Phone no.

For Disclosure, Privacy Act, and Paperwork Reduction Act Notice, see instructions. Civ. No. 1113299 Form **1040EZ** 2011

Are rules always followed?

Every spring, millions of Americans file their income tax forms. The different rules determine how much tax a person pays. There are also exceptions to the rules. You pay less tax if you are married and/or have children. There are certain limits on how much money you can make before paying taxes. The rule is that you pay taxes, but there are also exceptions based on your personal situation. The bonding rules for molecules are generally applicable, but there are some exceptions allowed.

Exceptions to the Octet Rule

As the saying goes, all rules are made to be broken. When it comes to the octet rule, that is true. Exceptions to the octet rule fall into one of three categories: (1) an **incomplete octet**, (2) **odd-electron molecules**, and (3) an **expanded octet**.

Incomplete Octet

In some compounds, the number of electrons surrounding the central atom in a stable molecule is fewer than eight. Beryllium is an alkaline earth metal and so may be expected to form ionic bonds. However, its very small size and somewhat higher ionization energy compared to other metals actually lead to beryllium forming primarily molecular compounds. Since beryllium only has two valence electrons, it does not typically attain an octet through

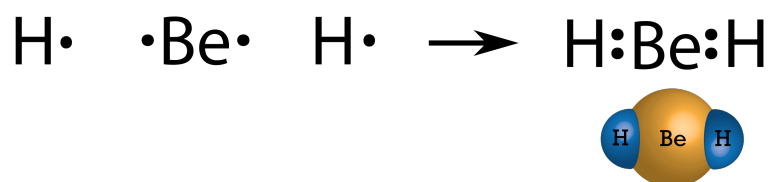


FIGURE 1.1

Beryllium hydride.

sharing of electrons. The Lewis structure of gaseous beryllium hydride (BeH_2) consists of two single covalent bonds between Be and H (see **Figure 1.1**).

Boron and aluminum, with three valence electrons, also tend to form covalent compounds with an incomplete octet. The central boron atom in boron trichloride (BCl_3) has six valence electrons as shown in **Figure 1.2**.

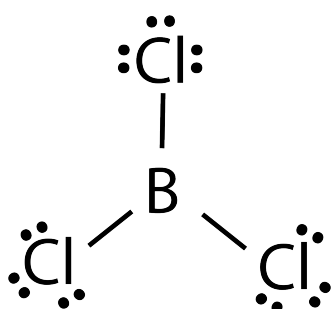


FIGURE 1.2

Boron trichloride.

Odd-Electron Molecules

There are a number of molecules whose total number of valence electrons is an odd number. It is not possible for all of the atoms in such a molecule to satisfy the octet rule. An example is nitrogen dioxide (NO_2). Each oxygen atom contributes six valence electrons and the nitrogen atom contributes five for a total of seventeen. The Lewis structure for NO_2 appears in **Figure 1.3**.

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FIGURE 1.3

The Lewis structure for nitrogen dioxide, an odd electron molecule.

Expanded Octets

Atoms of the second period cannot have more than eight valence electrons around the central atom. However, atoms of the third period and beyond are capable of exceeding the octet rule by having more than eight electrons around the central atom. Starting with the third period, the d sublevel becomes available, so it is possible to use these orbitals in bonding, resulting in an expanded octet.

Phosphorus and sulfur are two elements that react with halogen elements and make stable compounds with expanded octets. In phosphorus pentachloride, the central phosphorus atom makes five single bonds to chlorine atoms and as

a result has ten electrons surrounding it (see **Figure 1.4**). In sulfur hexafluoride, the central sulfur atom has twelve electrons from its six bonds to fluorine atoms (see **Figure 1.5**).

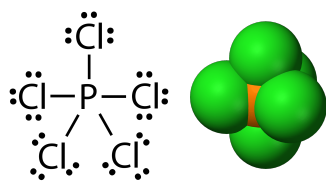


FIGURE 1.4

Phosphorus pentachloride. Left image: Lewis structure Right image: molecular model

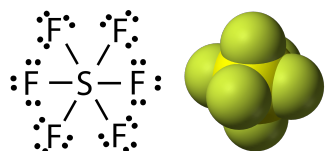
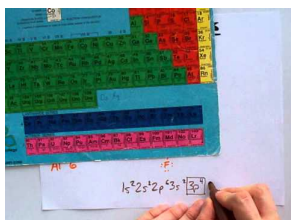


FIGURE 1.5

Sulfur hexafluoride. Left image: Lewis structure Right image: molecular model.



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Summary

- Exceptions exist to the rules for covalent bonding.
- These exceptions apply to atoms whose electrons will not accommodate the normal octet rule.

Review

1. What is an incomplete octet?
2. What is an odd-electron molecule?
3. Why are there extra electrons in the expanded octet?

- **expanded octet:** Use of d sublevel in bonding as well as other sublevels.
- **incomplete octet:** The number of electrons surrounding the central atom in a stable molecule is fewer than eight.
- **odd-electron molecules:** Molecules whose total number of valence electrons is an odd number.

References

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Molecular structure: <http://commons.wikimedia.org/wiki/File:Phosphorus-pentachloride-3D-vdW.png> .
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