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AnswerVerifiedHint: Chemical elements are the purest form of atoms. Atoms combine to form molecules. Chloroform is a molecule with the atoms of carbon, chlorine and hydrogen. There is a small electronegativity difference between these atoms, but this molecule is a polar molecule due to the asymmetrical distribution of bonds resulting in dipole moment leads to non-por molecule.Complete answer: Chloroform is a compound with the molecular formula of $ CHC{l_3} $ it consists of one carbon, one hydrogen and three chlorine atoms. The chloroform molecule exists in the $ s{p_3} $ hybridization and exhibits a tetrahedral geometry. The bonds involved in chloroform are $ 3C - Cl $ and $ 1C - H $ bonds. Though, there is not much difference in the value of electronegativity between these atoms it can have a polar nature and can be considered as a polar compound.As the four bonds involved in chloroform are not symmetrical, due to the difference in electronegativities, the $ 1C - H $ bond will be differently arranged and the geometry of the tetrahedron will be slightly distorted. Thus, there is an electron displacement and net dipole moment will arise in this molecule that leads to the polar character.Due to the dipole moment of chloroform, it can be considered as a polar.Note: The electronegativity difference between the carbon, chlorine and hydrogen is not greater than $ 1 $. Thus, it should be a covalent character, but it is a polar due to the dipole moment. Hence, not only the electronegativity difference, the net dipole moment, and geometry must be considered while writing the nonpolar or polar character. In addition to this, the shape of CHCl3 is tetrahedral having carbon on top and chlorine atoms at three vertices of the base of the pyramid. As a result, all three chlorine atom gives a net dipole in a downward direction. Therefore, chloroform is a polar substance. Is h2f polar or nonpolar? H2S is the polar molecule with Hydrogen atoms bonded outside the central Sulfur atom. It has an asymmetrical bent shape that creates a dipole moment between atoms. Sulfur is more electronegative than Hydrogen. Is BF2Cl a polar molecule? Re: Polarity and bond angles of BF2Cl and CHCl3 Answer: BF2Cl will be trigonal planar just like BF3. In both cases boron has 3 valence electrons and each of the halogens has 7 valence electrons. They will then form a total of three covalent bonds with the boron in the center. Is symmetrical polar or nonpolar? All symmetrical molecules are non-polar and all asymmetrical molecules are polar. Although symmetrical molecules may have dipoles the dipoles cancel out due to the symmetrical nature of the molecule. Is o2 polar or nonpolar? For example, molecular oxygen (O2) is nonpolar because the electrons will be equally distributed between the two oxygen atoms. Another example of a nonpolar covalent bond is methane (CH4), also shown in Figure 1. Carbon has four electrons in its outermost shell and needs four more to fill it. Is CBr4 polar or nonpolar? The CBr4 molecule is non-polar. The CH3Br molecule is polar. Both CBr4 and CH3Br have four regions of electrons around the central carbon atom. These are all bonding electron regions (clouds) so the shape of both molecules is tetrahedral. What type of bond is AlCl3? ionic What type of bond is NH3 polar or nonpolar? Each N-H bond in NH3 is polar / forms a dipole because the N and H atoms have different electronegativities. The shape of the molecule (due to the presence of one non-bonding electron pair) is trigonal pyramidal which is asymmetrical, so the dipoles / bond polarities do not cancel. The resulting NH3 molecule is polar. What is the difference between polar and nonpolar amino acids? Properties of amino acids are grouped based on the functional side chains (R), and one such property is hydrophobicity. If the R group is repelled by water, then it is hydrophobic (nonpolar), eg, valine; whereas hydrophilic (polar) amino acids are attracted to water, eg, arginine. How do polar and nonpolar molecules interact? Polar molecules and non-polar molecules interact with each other in different ways. Polar molecules interact with each other by forces such as dipole-dipole interactions whereas nonpolar molecules interact with each other through London dispersion forces. What are polar and non-polar molecules give examples? -Polar bonds have a net dipole moment and they generally are formed when there is no symmetry present within the molecule. Some examples of non-polar molecules which are caused due to symmetry are CCl4,CH3CH2CH3,CO2,O2. How can you tell if a molecule is polar or nonpolar without electronegativity? To review the steps: Draw the Lewis structure. Figure out the geometry (using VSEPR theory) Visualize or draw the geometry. Find the net dipole moment (you don't have to actually do calculations if you can visualize it) If the net dipole moment is zero, it is non-polar. Otherwise, it is polar. Which is stronger nonpolar or polar covalent? Non polar covalent bonds are the strongest as they have maximum overlapping in their atomic orbitals. This is also why covalent compounds rarely dissociate and even if they do , the do so to a very small extent. What is the difference between a polar bond and a polar molecule? A polar bond is one where the charge distribution between the two atoms in the bond is unequal. A polar molecule is one where the charge distribution around the molecule is not symmetric. It results from having polar bonds and also a molecular structure where the bond polarities do not cancel. Does having a polar bond always mean you will have a polar molecule? Polar and Nonpolar Covalent Compounds A polar covalent compound is one in which there is a slight difference in electric charge between opposite sides of the molecule. All polar compounds contain polar bonds. But having polar bonds does not necessarily result in a polar compound. What is a polar molecule simple definition? A polar molecule is a molecule in which one end of the molecule is slightly positive, while the other end is slightly negative. A diatomic molecule that consists of a polar covalent bond, such as HF, is a polar molecule. What causes a molecule to be polar? Likewise molecules in which there is an accumulation of electron density at one end of the molecule, giving that end a partial negative charge and the other a partial positive charge, are called polar molecules. This occurs because of a difference in electronegativity of the two atoms that share the electrons. How do polar bonds cancel out? A molecule like H-F has two different atoms attached to each other by a covalent bond. If a molecule has more than one polar bond, the molecule will be polar or nonpolar, depending on how the bonds are arranged. If the polar bonds are arranged symmetrically, the bond dipoles cancel and do not create a molecular dipole. InChI=1S/CHCl3/c2-1(3)4/h1HInChIKeyInChIKey=HEDRZPFGACZZDS-UHFFFAOYSA-NSMILESC(Cl)(Cl)ClCanonical SMILESClC(Cl)ClOther Names for this SubstanceMethane, trichloro-ChloroformTrichloromethaneTrichloroformR 20Deleted or Replaced CAS Registry Numbers8013-54-5 Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. CHCl3 is a POLAR molecule. But why? And how can you say that CHCl3 is a polar molecule? Want to know the reason?Let's dive into it! CHCl3 is a POLAR molecule because the C-Cl bonds present in the molecule are polar, which causes the partial positive (δ+) and partial negative (δ-) charge to appear on the molecule. These δ+ and δ- charges are responsible to make the entire CHCl3 molecule polar. Let me explain this in detail with the help of CHCl3 lewis structure and its 3D geometry. CHCl3 is a polar molecule because it has poles of partial positive charge (δ+) and partial negative charge (δ-) on it. Let me explain this to you in 2 steps! Here is a skeleton of CHCl3 lewis structure and it contains one C-H bond and three C-Cl bond. (Note: If you want to know the steps of drawing the CHCl3 lewis dot structure, then visit this article: CHCl3 lewis structure, Or you can also watch this short 2 minute video). So from the above diagram we have come to know that the CHCl3 molecule has one C-H bond and three C-Cl bonds. Now in the next step we have to check whether the C-H bond and C-Cl bonds are polar or nonpolar. And we also have to check the molecular geometry of CHCl3. The chemical bonds can be either nonpolar, polar or ionic depending on the difference of the electronegativity values (ΔEN) between the two atoms. Have a look at the above image. If the electronegativity difference (ΔEN) is less than 0.4, then the bond is nonpolar covalent bond. If the electronegativity difference (ΔEN) is between 0.4 to 1.7, then the bond is polar covalent bond. If the electronegativity difference (ΔEN) is greater than 1.7, then the bond is an ionic bond. [1] [2] [3] [4] [5] Now let's come to the example of CHCl3 molecule. It has one C-H bond and three C-Cl bonds. You can see the electronegativity values of Carbon (C), Hydrogen (H) and Chlorine (Cl) atoms from the periodic table given below. From the above image; Electronegativity of Carbon (C) = 2.55 [6] Electronegativity of Hydrogen (H) = 2.2 [7] Electronegativity of Chlorine (Cl) = 3.16 [8] Now let's see the polarity of each bond. For C-H bond; The electronegativity difference (ΔEN) = 2.55 – 2.2 = 0.35 This value is less than 0.4, which indicates that the bond between Carbon (C) and Hydrogen (H) is nonpolar.Hence, each C-H bond is a nonpolar covalent bond. For C-Cl bond; The electronegativity difference (ΔEN) = 3.16 – 2.55 = 0.61 This value lies between 0.4 to 1.7, which indicates that the bond between Carbon (C) and Chlorine (Cl) is polar.Hence, the C-Cl bond is a polar covalent bond. You can see in the above image that because of large electronegativity difference of Carbon and Chlorine atom, the partial positive charge (δ+) appears on the Carbon atom (C) and partial negative charge (δ-) appears on the Chlorine atoms (Cl). From this, you can easily get the idea that the CHCl3 molecule is a polar molecule. But let's also see its 3D molecular geometry for better understanding. Have a look at this 3D structure of CHCl3. The more electronegative chlorine atom (Cl) has a tendency to pull the shared electron pair towards itself, which results in partial positive charge on carbon atom (C) and partial negative charge on chlorine atoms (Cl). Because of this, there are positive and negative poles of charges on the overall molecule of CHCl3. Hence, the CHCl3 molecule is a polar molecule. I hope you have understood the reason behind the polar nature of CHCl3 molecule. See the polarity of other molecules to make your concepts clear:Is NF3 Polar or Nonpolar?Is CH3OH (Methanol) Polar or Nonpolar?Is SCl2 Polar or Nonpolar?Is Br2 Polar or Nonpolar?Is PF3 Polar or Nonpolar? The IUPAC name for CHCl3 is trichloromethane however you must have heard about it by its commonly used commercial name i.e., chloroform. Chloroform is a colorless, dense liquid with a very strong smell. The IUPAC name for chloroform suggests that it is made up of three chlorine atoms bonded to a carbon atom at the center. Chloroform is formed when the 3 hydrogen atoms of methane (CH4) get replaced by three halogen (Cl) atoms thus the name trichloromethane. If you have any doubt about the polarity of CHCl3 then this article is exactly what you are looking for, that is: Is CHCl3 polar or non-polar? Is CHCl3 polar or non-polar? Chloroform (CHCl3) is a polar molecule. Chlorine (Cl) is a highly electronegative element. It attracts the shared electron cloud of each of the three C-Cl bonds as well as the C-H bond. Oppositely charged poles develop in the molecule. CHCl3 has an apparently symmetric tetrahedral shape or geometry. However, dipole moments of individually polar C-Cl bonds do not get canceled even in this tetrahedral shape. There is an overall unbalanced electron cloud density in the molecule thus CHCl3 is a polar molecule with a net μ > 0. Name of molecule Trichloromethane or chloroform (CHCl3) Bond type Polar covalent Molecular geometry Tetrahedral Polar or Non-polar? Polar molecule Dipole moment 1.08 D Bond angle 109.5º Polar versus non-polar molecules Different factors control the polarity of covalently bonded molecules. Three of these most important factors are: Electronegativity Dipole moment Molecular geometry or shape Based on all these factors, a molecule is polar if it has an overall non-uniform electron cloud density. On the other hand, molecules are non-polar if they have a balanced net charge distribution. This happens when the dipole moments of individually polar bonds get canceled in opposite directions due to the symmetrical shape of the molecule. Now let's see how all the above-mentioned factors make CHCl3 a polar molecule with a non-uniform electron cloud distribution overall. Factors affecting the polarity of CHCl3 Electronegativity Electronegativity is defined as the ability of an atom to attract a shared pair of electrons from a covalent bond. According to the Pauling scale, a covalent bond is polar if the bonded atoms have an electronegativity difference between 0.5 to 1.6 units. No covalent bond is purely non-polar unless it is made up of two identical atoms such as an oxygen (O2) molecule or hydrogen (H2) molecule. Therefore, although there is a small electronegativity difference between a C (E.N = 2.55) and an H (E.N= 2.20) atom, electronegativity difference = 0.35 < 0.5, but still a C-H bond in CHCl3 is slightly polar. Atom Electronic configuration Valence electrons Carbon (6C) 1s2 2s2 2p2 4 Hydrogen (1H) 1s1 1 Chlorine (17Cl) 1s2 2s2 2p63s23p5 7 Halogens present in group VII A (or group 17) of the Periodic Table are highly electronegative elements. The halogens are short of a single electron only to complete their octet electronic configuration, so they strongly attract the shared electron cloud from a covalent bond. Chlorine is a halogen with a high electronegativity (E.N = 3.16). There is a high electronegativity difference between a C and a Cl atom i.e., 3.16 – 2.55= 0.61 > 0.5, thus each C-Cl bond in the CHCl3 molecule is polar. The three Cl atoms not only attract the shared electron cloud of each C-Cl bond but also that of the C-H bond. These electronegativity differences generate oppositely charged positive (Cδ+) and negative (Clδ-) poles in the chloroform molecule. Dipole moment Dipole moment (μ) is a vector quantity defined as the product of electrical charge (Q) and charge separation (r). The charge separation is measured from the center of the positive pole to the center of the negative pole. The dipole moment of the C-Cl bond points from the partial positively charged center (Cδ+) to the partial negatively charged center (Clδ-). A carbon atom is comparatively more electronegative than a hydrogen atom so the dipole moment of the C-H bond points from Cδ+ to Hδ++. Molecular geometry or shape Carbon belongs to group IV A (or group 14) of the Periodic Table. It has 4 valence electrons available for bonding. In CHCl3, the central carbon is bonded to 1 hydrogen and 3 chlorine atoms. In this way, the carbon, as well as all the chlorine atoms, achieve a stable octet electronic configuration while hydrogen completes its duplet. All the valence electrons of carbon get involved in covalent bond formation in CHCl3. So, there are 4 bond pairs (B) around the central carbon atom (A) and no lone pair. Such a molecule is known as an AB4 type molecule according to the Valence Shell Electron Pair Repulsion (VSEPR) theory of chemical bonding. The molecule (CHCl3) has a tetrahedral geometry with a mutual bond angle of 109.5°. Although tetrahedral is technically a symmetrical shape as 4 atoms are present at the four corners of a tetrahedron. But in this case, the downwards pointing Cl bonds attract the shared electron cloud of the C-H bond in addition to attracting the electrons from each C-Cl bond. This leads to a disturbed/asymmetrical electron cloud over the molecule. The dipole moments of individual C-Cl bonds do not get canceled rather the polarity effect adds up to yield a polar CHCl3 molecule. It has a net dipole moment of 1.08 D. Also check – FAQ CHCl3 is a polar molecule because the shared electron cloud is asymmetrically distributed over the tetrahedral shape of the molecule. Halogen atoms are highly electronegative, so the Cl atoms present in CHCl3 attract the shared electron cloud of not only the C-Cl bonds but also the C-H bond. Dipole moments of individually polar bonds do not get canceled in CHCl3 overall so it is a polar molecule. CHCl3 is partially miscible with water due to its polar ends but CHCl3 cannot form hydrogen bonding with H2O molecules. Thus, CHCl3 does not completely dissolve in water. For H-bonding, hydrogen atoms must be directly bonded to the electronegative atoms. Methane (CH4) is made up of four equivalent C-H bonds. Carbon is slightly more electronegative than hydrogen, so each C-H bond is weakly polar. But the dipole moments of these weakly polar bonds get canceled in opposite directions due to the symmetric tetrahedral shape of the CH4. Thus, CH4 is a non-polar molecule with a net μ =0. Trichloromethane (CHCl3) is formed by replacing H-atoms with three highly electronegative Cl atoms. Cl attracts the shared electron cloud from the C-H bond in addition to attracting the electrons from each C-Cl bond. Thus, CHCl3 has an asymmetric non-uniformly distributed electron cloud overall and it is polar with a net μ > 0. CH3Cl (μ = 1.87 D) is more polar as compared to CHCl3 (μ= 1.08 D). One Cl atom present at the apex of a tetrahedron more strongly attracts the shared electron cloud from each C-H bond as compared to three Cl atoms attracting the electron cloud from a single C-H bond. Some dipole moment cancelation occurs in the CHCl3 molecule which decreases the net dipole moment value of the molecule as opposed to the net dipole moment in the CH3Cl molecule. Why is CHCl3 a polar molecule but considered a non-polar solvent? CHCl3 is a polar molecule on account of the difference in the electronegativity of its bonded atoms. But it is generally considered a non-polar organic solvent in the chemistry laboratory because a large number of CHCl3 molecules together have a low dielectric constant. The central carbon atom in CHCl3 is sp3. The electronic configuration of carbon is 1s22s22p2 and the electronic configuration of chlorine is 1s22s22p63s23p5. During bond formation in CHCl3, one 2s electron of C shifts to the empty 2p orbital. The 2s and three 2p orbitals hybridize to produce four sp3 hybrid orbitals, each containing a single unpaired electron. One sp3 hybrid orbital overlaps with the s orbital of H to form a C-H sigma (σ) bond while the other three sp3 hybrid orbitals overlap with the p orbitals of Cl to form the remaining 3 sigmas (σ) bonds. Summary Chloroform (CHCl3) is a polar molecule. It has three Cl atoms and one H atom bonded to a C at the center. There is a significant electronegativity difference (0.61 units) between the bonded C and Cl atoms. Cl strongly attracts the shared electron cloud from each C-Cl bond. There is a small electronegativity difference between the bonded C and H atoms, so Cl attracts the electron cloud of the C-H bond as well. The electronic geometry and shape of the CHCl3 molecule is tetrahedral with a mutual bond angle of 109.5° but the shared electron cloud of the molecule is not balanced overall. Thus, CHCl3 is overall polar with a net dipole moment of 1.08 D. CHCl3, historical anaesthetic and common solventFor other uses, see Chloroform (disambiguation). You can help expand this article with text translated from the corresponding article in Turkish. (September 2024) Click [show] for important translation instructions. View a machine-translated version of the Turkish article. Machine translation, like DeepL or Google Translate, is a useful starting point for translations, but translators must revise errors as necessary and confirm that the translation is accurate, rather than simply copy-pasting machine-translated text into the English Wikipedia. Consider adding a topic to this template: there are already 229 articles in the main category, and specifying|topic= will aid in categorization. Do not translate text that appears unreliable or low-quality. If possible, verify the text with references provided in the foreign-language article. You must provide copyright attribution in the edit summary accompanying your translation by providing an interlanguage link to the source of your translation. A model attribution edit summary is Content in this edit is translated from the existing Turkish Wikipedia article at [[:tr:Kloroform]]; see its history for attribution. You may also add the template {{Translated|tr|Kloroform}} to the talk page. For more guidance, see Wikipedia:Translation. Chloroform Chloroform in its liquid state shown in a test tube Names Preferred IUPAC name Trichloromethane Other names ChloroformiumFreon 20Methane trichlorideMethyl trichlorideMethenyl trichlorideMethenyl chlorideRefrigerant-20terchloride/perchloride of formyle[1][2] (archaic)Trichloretum Formylicum (Latin) Identifiers CAS Number 67-66-3 Y 3D model (JSmol) Interactive image Abbreviations R-20, TCM ChEBI CHEBI:35255 Y ChEMBL ChEMBL44618 Y ChemSpider 5977 Y ECHA InfoCard 100.000.603 EC Number 200-663-8 KEGG C13827 Y PubChem CID 6212 RTECS number FS9100000 UNII 7V31YC746X Y UN number 1888 CompTox Dashboard (EPA) DTXSID1020306 InChI InChI=1S/CHCl3/c2-1(3)4/h1H YKey: HEDRZPFGACZZDS-UHFFFAOYSA-N YInChI=1/CHCl3/c2-1(3)4/h1HKey: HEDRZPFGACZZDS-UHFFFAOYAG SMILES ClC(Cl)Cl Properties Chemical formula CHCl3 Molar mass 119.37 g·mol−1 Appearance Highly refractive colorless liquid Odor Sweet, minty, pleasant Density 1.564 g/cm3 (−20 °C) 1.489 g/cm3 (25 °C) 1.394 g/cm3 (60 °C) Melting point −63.5 °C (−82.3 °F; 209.7 K) Boiling point 61.15 °C (142.07 °F; 334.30 K) decomposes at 450 °C Solubility in water 10.62 g/L (0 °C) 8.09 g/L (20 °C) 7.32 g/L (60 °C) Solubility Soluble in benzene Miscible in diethyl ether, oils, ligroin, alcohol, CCl4, CS2 Solubility in acetone ≥ 100 g/L (19 °C) Solubility in dimethyl sulfoxide ≥ 100 g/L (19 °C) Vapor pressure 0.62 kPa (−40 °C) 7.89 kPa (0 °C) 25.9 kPa (25 °C) 313 kPa (100 °C) 2.26 MPa (200 °C) Henry's lawconstant (kH) 3.67 L·atm/mol (24 °C) Acidity (pKa) 15.7 (20 °C) UV-vis (λmax) 250 nm, 260 nm, 280 nm Magnetic susceptibility (χ) −59.30·10−6 cm3/mol Thermal conductivity 0.13 W/(m·K) (20 °C) Refractive index (nD) 1.4459 (20 °C) Viscosity 0.563 cP (20 °C) Structure Molecular shape Tetrahedral Dipole moment 1.15 D Thermochemistry Heat capacity (C) 114.25 J/(mol·K) Std molarentropy (S298) 202.9 J/(mol·K) Std enthalpy offormation (ΔfH298) −134.3 kJ/mol Gibbs free energy (ΔfG) −71.1 kJ/mol Std enthalpy ofcombustion (ΔcH298) 473.21 kJ/mol Pharmacology ATC code N01AB02 (WHO) Hazards[8] Occupational safety and health (OHS/OSH): Main hazards Decomposes into phosgene and hydrogen chloride in presence of heat – likely carcinogenic – reproductive toxicity – hepatotoxic[3][4] GHS labelling: Pictograms Signal word Danger Hazard statements H302, H315, H319, H331, H336, H351, H361d, H372 Precautionary statements P201, P202, P235, P260, P264, P270, P271, P280, P281, P301+P330+P331, P302+P352, P304+P340, P305+P351+P338, P308+P313, P310, P311, P314, P332+P313, P337+P313, P362, P403+P233, P405, P501 NFPA 704 (fire diamond) 2 0 1 Flash point Nonflammable Lethal dose or concentration (LD, LC): LD50 (median dose) 704 mg/kg (mouse, dermal)[5] LC50 (median concentration) 47,702 mg/m3 (rat, 4 hr)[6] LCLo (lowest published) 20,000 ppm (guinea pig, 2 hr)7,056 ppm (cat, 4 hr)25,000 ppm (human, 5 min)[7][clarification needed] NIOSH (US health exposure limits): PEL (Permissible) 50 ppm (240 mg/m3)[3] REL (Recommended) Ca ST 2 ppm (9.78 mg/m3) [60-minute][3] IDLH (Immediate danger) 500 ppm[3][clarification needed] Safety data sheet (SDS) [1] Related compounds Related compounds Deuterated chloroform CDCl3Chloromethane CH3ClDichloromethane CH2Cl2Tetrachloromethane CCl4Fluoroform CHF3Bromoform CHBr3Iodoform CHI3Chlorodifluoromethane CHF2ClDichlorofluoromethane CHFCl2Bromodichloromethane CHCl2BrDibromochloromethane CHClBr2Bromodifluoromethane CHF2BrDibromofluoromethane CHFBr2 Supplementary data page Chloroform (data page) Except where otherwise noted, data are given for materials in their standard state (at 25 °C [77 °F], 100 kPa). Y verify (what is YN ?) Infobox references Chemical compound Chloroform,[9] or trichloromethane (often abbreviated as TCM), is an organochloride with the formula CHCl3 and a common solvent. It is a volatile, colorless, sweet-smelling, dense liquid produced on a large scale as a precursor to refrigerants and PTFE.[10] Chloroform was once used as an inhalational anesthetic between the 19th century and the first half of the 20th century.[11][12] It is miscible with many solvents but it is only very slightly soluble in water (only 8 g/L at 20°C). The molecule adopts a tetrahedral molecular geometry with C3v symmetry.[13] The chloroform molecule can be viewed as a methane molecule with three hydrogen atoms replaced with three chlorine atoms, leaving a single hydrogen atom. The name "chloroform" is a portmanteau of terchloride (tertiary chloride, a trichloride) and formyle, an obsolete name for the methylylidene radical (CH) derived from formic acid.[citation needed] Many kinds of seaweed produce chloroform, and fungi are believed to produce chloroform in soil.[14] Abiotic processes are also believed to contribute to natural chloroform productions in soils, although the mechanism is still unclear.[15] Chloroform is a volatile organic compound.[16] Chloroform was synthesized independently by several investigators c. 1831: Moldenhawer, a German pharmacist from Frankfurt an der Oder, appears to have produced chloroform in 1830 by mixing chlorinated lime with ethanol; however, he mistook it for Chloräther (chloric ether, 1,2-dichloroethane).[17][18] Samuel Guthrie, a U.S. physician from Sackets Harbor, New York, also appears to have produced chloroform in 1831 by reacting chlorinated lime with ethanol, and noted its anaesthetic properties; however, he also believed that he had prepared chloric ether.[19][20][21] Justus von Liebig carried out the alkaline cleavage of chloral. Liebig incorrectly states that the empirical formula of chloroform was C2Cl5 and named it "Chlorkohlenstoff" ("carbon chloride").[22][23] Eugène Soubeiran obtained the compound by the action of chlorine bleach on both ethanol and acetone.[24] In 1834, French chemist Jean-Baptiste Dumas determined chloroform's empirical formula and named it:[25] "Es scheint mir also erweisen, dass die von mir analysirte Substanz, ... zur Formel hat: C2H2Cl6." (Thus it seems to me to show that the substance I analyzed ... has as [its empirical] formula: C2H2Cl6.). [Note: The coefficients of his empirical formula should be halved.] ... "Diess hat mich veranlasst diese Substanz mit dem Namen 'Chloroform' zu belegen." (This had caused me to impose the name "chloroform" upon this substance [i.e., formyl chloride or chloride of formic acid].) In 1835, Dumas prepared the substance by alkaline cleavage of trichloroacetic acid. In 1842, Robert Mortimer Glover in London discovered the anaesthetic qualities of chloroform on laboratory animals.[26] In 1847, Scottish obstetrician James Y. Simpson was the first to demonstrate the anaesthetic properties of chloroform (provided by local pharmacist William Flockhart of Duncan, Flockhart and company,[27]) in humans, and helped to popularize the drug for use in medicine.[28] By the 1850s, chloroform was being produced on a commercial basis. In Britain, about 750,000 doses a week were being produced by 1895,[29] using the Liebig procedure, which retained its importance until the 1960s. Today, chloroform – along with dichloromethane – is prepared exclusively and on a massive scale by the chlorination of methane and chloromethane.[10] Industrially, chloroform is produced by heating a mixture of chlorine and either methyl chloride (CH3Cl) or methane (CH4).[10] At 400–500 °C, free radical halogenation occurs, converting these precursors to progressively more chlorinated compounds: CH4 + Cl2 → CH3Cl + HCl CH3Cl + Cl2 → CH2Cl2 + HCl CH2Cl2 + Cl2 → CHCl3 + HCl Chloroform undergoes further chlorination to yield carbon tetrachloride (CCl4): CHCl3 + Cl2 → CCl4 + HCl The output of this process is a mixture of the four chloromethanes: chloromethane, methylene chloride (dichloromethane), trichloromethane (chloroform), and tetrachloromethane (carbon tetrachloride). These can then be separated by distillation.[10] Chloroform may also be produced on a small scale via the haloform reaction between acetone and sodium hypochlorite: 3 NaOCl + (CH3)2CO → CHCl3 + 2 NaOH + CH3COONa Main article: Deuterated chloroform Deuterated chloroform is an isotopologue of chloroform with a single deuterium atom. CDCl3 is a common solvent used in NMR spectroscopy. Deuterochloroform is produced by the reaction of hexachloroacetone with heavy water.[30] The haloform process is now obsolete for production of ordinary chloroform. Deuterochloroform can also be prepared by reacting sodium deuteroxide with chloral hydrate.[31][32] The haloform reaction can also occur inadvertently in domestic settings. Sodium hypochlorite solution (chlorine bleach) mixed with common household liquids such as acetone, methyl ethyl ketone, ethanol, or isopropyl alcohol can produce some chloroform, in addition to other compounds, such as chloroacetone or dichloroacetone.[citation needed] In terms of scale, the most important reaction of chloroform is with hydrogen fluoride to give monochlorodifluoromethane (HCFC-22), a precursor in the production of polytetrafluoroethylene (Teflon) and other fluoropolymers:[10] CHCl3 + 2 HF → CHClF2 + 2 HCl The reaction is conducted in the presence of a catalytic amount of mixed antimony halides. Chlorodifluoromethane is then converted to tetrafluoroethylene, the main precursor of Teflon.[33] The hydrogen attached to carbon in chloroform participates in hydrogen bonding,[34][35] making it a good solvent for many materials. Worldwide, chloroform is also used in pesticide formulations, as a solvent for lipids, rubber, alkaloids, waxes, gutta-percha, and resins, as a cleaning agent, as a grain fumigant, in fire extinguishers, and in the rubber industry.[36][37] CDCl3 is a common solvent used in NMR spectroscopy.[38] Chloroform is used as a precursor to make R-22 (chlorodifluoromethane). This is done by reacting it with a solution of hydrofluoric acid (HF) which fluorinates the CHCl3 molecule and releases hydrochloric acid as a byproduct.[39] Before the Montreal Protocol was enforced, most of the chloroform produced in the United States was used in the production of chlorodifluoromethane. However, its production remains high, as it is a key precursor of PTFE.[40] Although chloroform has properties such as a low boiling point, and a low global warming potential of only 31 (compared to the 1760 of R-22), which are appealing properties for a refrigerant, there is little information to suggest that it has seen widespread use as a refrigerant in any consumer products.[41] In solvents such as CCl4 and alkanes, chloroform hydrogen bonds to a variety of Lewis bases. HCCl3 is classified as a hard acid, and the ECW model lists its acid parameters as EA = 1.56 and CA = 0.44. As a reagent, chloroform serves as a source of the dichlorocarbene intermediate CCl2.[42] It reacts with aqueous sodium hydroxide, usually in the presence of a phase transfer catalyst, to produce dichlorocarbene, CCl2.[43][44] This reagent effects ortho-formylation of activated aromatic rings, such as phenols, producing aryl aldehydes in a reaction known as the Reimer–Tiemann reaction. Alternatively, the carbene can be trapped by an alkene to form a cyclopropane derivative. In the Kharasch addition, chloroform forms the •CHCl2 free radical which adds to alkenes.[citation needed] Antique bottles of chloroform Chloroform is a powerful general anesthetic, euphoriant, anxiolytic, and sedative when inhaled or ingested. The anaesthetic qualities of chloroform were first described in 1842 in a thesis by Robert Mortimer Glover, which won the Gold Medal of the Harveian Society for that year.[45][46] Glover also undertook practical experiments on dogs to prove his theories, refined his theories, and presented them in his doctoral thesis at the University of Edinburgh in the summer of 1847, identifying anaesthetizing halogenous compounds as a "new order of poisonous substances".[45] The Scottish obstetrician James Young Simpson was one of those examiners required to read the thesis, but later claimed to have never read it and to have come to his own conclusions independently.[45] Perkins-McVey, among others, have raised doubts about the credibility of Simpson's claim, noting that Simpson's publications on the subject in 1847 explicitly echo Glover's and, being one of the thesis examiners, Simpson was likely aware of the content of Glover's study, even if he skirted his duties as an examiner.[45] In 1847 and 1848, Glover would pen a series of heated letters accusing Simpson of stealing his discovery, which had already earned Simpson considerable notoriety.[45] Whatever the source of his inspiration, on 4 November 1847, Simpson argued that he had discovered the anaesthetic qualities of chloroform in humans. He and two colleagues entertained themselves by trying the effects of various substances, and thus revealed the potential for chloroform in medical procedures.[27] An illustration depicting James Young Simpson and his friends found unconscious. A few days later, during the course of a dental procedure in Edinburgh, Francis Brodie Imlach became the first person to use chloroform on a patient in a clinical context.[47] In May 1848, Robert Halliday Gunning made a presentation to the Medico-Chirurgical Society of Edinburgh following a series of laboratory experiments on rabbits that confirmed Glover's findings and also refuted Simpson's claims of originality. The laboratory experiments that proved the dangers of chloroform were largely ignored.[48] The use of chloroform during surgery expanded rapidly in Europe; for instance in the 1850s chloroform was used by the physician John Snow during the births of Queen Victoria's last two children Leopold and Beatrice.[49] In the United States, chloroform began to replace ether as an anesthetic at the beginning of the 20th century;[50] it was abandoned in favor of ether on discovery of its toxicity, especially its tendency to cause fatal cardiac arrhythmias analogous to what is now termed "sudden sniffer's death". Some people used chloroform as a recreational drug or to attempt suicide.[51] One possible mechanism of action of chloroform is that it increases the movement of potassium ions through certain types of potassium channels in nerve cells.[52] Chloroform could also be mixed with other anesthetic agents such as ether to make C.E. mixture,[53] or ether and alcohol to make A.C.E. mixture.[54][55] In 1848, Hannah Greener, a 15-year-old girl who was having an infected toenail removed, died after being given the anaesthetic.[56] Her autopsy establishing the cause of death was undertaken by John Fife assisted by Robert Mortimer Glover.[26] A number of physically fit patients died after inhaling it. In 1848, however, John Snow developed an inhaler that regulated the dosage and so successfully reduced the number of deaths.[57] The opponents and supporters of chloroform disagreed on the question of whether the medical complications were due to respiratory disturbance or whether chloroform had a specific effect on the heart. Between 1864 and 1910, numerous commissions in Britain studied chloroform but failed to come to any clear conclusions. It was only in 1911 that Levy proved in experiments with animals that chloroform can cause ventricular fibrillation.[58] Despite this, between 1865 and 1920, chloroform was used in 80 to 95% of all narcoses performed in the UK and German-speaking countries. In Germany, comprehensive surveys of the fatality rate during anaesthesia were made by Gurlt between 1890 and 1897.[50] At the same time in the UK the medical journal The Lancet carried out a questionnaire survey[59] and compiled a report detailing numerous adverse reactions to anesthetics, including chloroform.[60] In 1934, Killian gathered all the statistics compiled until then and found that the chances of suffering fatal complications under ether were between 1:14,000 and 1:28,000, whereas with chloroform the chances were between 1:3,000 and 1:6,000.[50] The rise of gas anaesthesia using nitrous oxide, improved equipment for administering anesthetics, and the discovery of hexobarbital in 1932 led to the gradual decline of chloroform narcosis.[61] The latest reported anaesthetic use of chloroform in the Western world dates to 1987, when the last doctor who used it retired, about 140 years after its first use.[62] Damsels in distress being knocked out with chloroform in various media Chloroform has been used by criminals to knock out, daze, or murder victims. Joseph Harris was charged in 1894 with using chloroform to rob people.[63] Serial killer H. H. Holmes used chloroform overdoses to kill his female victims. In September 1900, chloroform was implicated in the murder of the U.S. businessman William Marsh Rice. Chloroform was deemed a factor in the alleged murder of a woman in 1991, when she was asphyxiated while asleep.[64] In 2002, 13-year-old Kacie Woody was sedated with chloroform when she was abducted by David Fuller and during the time that he had her, before he shot and killed her.[65] In a 2007 plea bargain, a man confessed to using stun guns and chloroform to sexually assault minors.[66] The use of chloroform as an incapacitating agent has become widely recognized, bordering on cliché, through the adoption by crime fiction authors of plots involving criminals' use of chloroform-soaked rags to render victims unconscious. However, it is nearly impossible to incapacitate someone using chloroform in this way.[67] It takes at least five minutes of inhalation of chloroform to render a person unconscious. Most criminal cases involving chloroform involve co-administration of another drug, such as alcohol or diazepam, or the victim being complicit in its administration. After a person has lost consciousness owing to chloroform inhalation, a continuous volume must be administered, and the chin must be supported to keep the tongue from obstructing the airway, a difficult procedure, typically requiring the skills of an anesthesiologist. In 1865, as a direct result of the criminal reputation chloroform had gained, the medical journal The Lancet offered a "permanent scientific reputation" to anyone who could demonstrate "instantaneous insensibility", i.e. loss of consciousness, using chloroform.[68] Chloroform is formed as a by-product of water chlorination, along with a range of other disinfection by-products, and it is therefore often present in municipal tap water and swimming pools. Reported ranges vary considerably, but are generally below the current health standard for total trihalomethanes (THMs) of 100 μg/L.[69] However, when considered in combination with other trihalomethanes often present in drinking water, the concentration of THMs often exceeds the recommended limit of exposure.[70] Historically, chloroform exposure may well have been higher, owing to its common use as an anesthetic, as an ingredient in cough syrups, and as a constituent of tobacco smoke, where DDT had previously been used as a fumigant.[71] Chloroform is well absorbed, metabolized, and eliminated rapidly by mammals after oral, inhalation, or dermal exposure. Accidental splashing into the eyes has caused irritation.[36] Prolonged dermal exposure can result in the development of sores as a result of defatting. Elimination is primarily through the lungs as chloroform and carbon dioxide; less than 1% is excreted in the urine.[37] Chloroform is metabolized in the liver by the cytochrome P-450 enzymes, by oxidation to trichloromethanol and by reduction to the dichloromethyl free radical. Other metabolites of chloroform include hydrochloric acid and diglutathionyl dithiocarbonate, with carbon dioxide as the predominant end-product of metabolism.[72] Like most other general anesthetics and sedative-hypnotic drugs, chloroform is a positive allosteric modulator at GABAA receptors.[73] Chloroform causes depression of the central nervous system (CNS), ultimately producing deep coma and respiratory center depression.[72] When ingested, chloroform causes symptoms similar to those seen after inhalation. Serious illness has followed ingestion of 7.5 g (0.26 oz). The mean lethal oral dose in an adult is estimated at 45 g (1.6 oz).[36] The anesthetic use of chloroform has been discontinued, because it caused deaths from respiratory failure and cardiac arrhythmias. Following chloroform-induced anesthesia, some patients suffered nausea, vomiting, hyperthermia, jaundice, and coma owing to hepatic dysfunction. At autopsy, liver necrosis and degeneration have been observed.[36] The hepatotoxicity and nephrotoxicity of chloroform is thought to be due largely to phosgene, one of its metabolites.[72] Chloroform converts slowly in the presence of UV light and air to the extremely poisonous gas phosgene (COCl2), releasing HCl in the process.[74] 2 CHCl3 + O2 → 2 COCl2 + 2 HCl To prevent accidents, commercial chloroform is stabilized with ethanol or amylene, but samples that have been recovered or dried no longer contain any stabilizer. Amylene has been found to be ineffective, and the phosgene can affect analytes in samples, lipids, and nucleic acids dissolved in or extracted with chloroform.[75] When ethanol is used as a stabiliser for chloroform, it reacts with phosgene (which is soluble in chloroform) to form the relatively harmless diethyl carbonate ester: 2 CH3CH2OH + COCl2 → CO3(CH2CH3)2 + 2 HCl Phosgene and HCl can be removed from chloroform by washing with saturated aqueous carbonate solutions, such as sodium bicarbonate. This procedure is simple and results in harmless products. Phosgene reacts with water to form carbon dioxide and HCl,[76] and the carbonate salt neutralizes the resulting acid.[77] Suspected samples can be tested for phosgene using filter paper which when treated with 5% diphenylamine, 5% dimethylaminobenzaldehyde in ethanol, and then dried, turns yellow in the presence of phosgene vapour.[78] There are several colorimetric and fluorometric reagents for phosgene, and it can also be quantified using mass spectrometry.[79] Chloroform is suspected of causing cancer (i.e. it is possibly carcinogenic, IARC Group 2B) as per the International Agency for Research on Cancer (IARC) Monograph. There is no convincing evidence that chloroform causes cancer in humans.[80] It is classified as an extremely hazardous substance in the United States, as defined in Section 302 of the US Emergency Planning and Community Right-to-Know Act (42 U.S.C. 11002), and is subject to strict reporting requirements by facilities that produce, store, or use it in significant quantities.[81] Some anaerobic bacteria use chloroform for respiration, termed organohalide respiration, converting it to dichloromethane.[82][83] CHCl3 measured by the Advanced Global Atmospheric Gases Experiment (AGAGE) in the lower atmosphere (troposphere) at stations around the world. Abundances are given as pollution free monthly mean mole fractions in parts-per-trillion (ppt). Joseph Thomas Clover ^ Gregory, William, A Handbook of Organic Chemistry (Third edition corrected and much extended), 1852, page 177 ^ Daniel Pereira Gardner, Medicinal Chemistry for the Use of Students and the Profession: Being a Manual of the Science, with Its Applications to Toxicology, Physiology, Therapeutics, Hygiene, Etc (1848), page 271 ^ a b c d NIOSH Pocket Guide to Chemical Hazards. "#0127". National Institute for Occupational Safety and Health (NIOSH). ^ Toxicity on PubChem Archived 17 August 2018 at the Wayback Machine ^ Lewis, Richard J. (2012). Sax's Dangerous Properties of Industrial Materials (12th ed.). Wiley. ISBN 978-0-470-62325-1. ^ "Chloroform" (PDF). Environmental Protection Agency. September 2016. Retrieved 19 February 2024. ^ "Chloroform". Immediately Dangerous to Life or Health Concentrations (IDLH). National Institute for Occupational Safety and Health (NIOSH). ^ "PubChem: Safety and Hazards – GHS Classification". 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Retrieved 12 May 2016.On p. 653, Dumas states chloroform's empirical formula: "Es scheint mir also erweisen, dass die von mir analysirte Substance, … zur Formel hat: C2H2Cl6." (Thus it seems to me to show that the substance [that was] analyzed by me … has as [its empirical] formula: C2H2Cl6.) [Note: The coefficients of his empirical formula must be halved.] Dumas then notes that chloroform's simple empirical formula resembles that of formic acid. Furthermore, if chloroform is boiled with potassium hydroxide, one of the products is potassium formate. On p. 654, Dumas names chloroform: "Diess hat mich veranlasst diese Substanz mit dem Namen 'Chloroform' zu belegen." (This caused me to bestow this substance with the name "chloroform" [i.e., formyl chloride or chloride of formic acid].) Reprinted in Dumas, J.-B. (1835). "Ueber die Wirkung des Chlors auf den Alkohol" [On the action of chlorine on alcohol]. Annalen der Pharmacie. 16 (2): 164–171. doi:10.1002/jlac.18350160213. 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NIST Standard Reference Database Retrieved from " 2Investigational antidepressant compound Pharmaceutical compound 4-ChlorokynurenineClinical dataOther names4-Cl-KYN; AV-101; 3-(4-Chloroanthraniloyl)-DL-alanineRoutes ofadministrationBy mouthDrug classNMDA receptor antagonistATC codeNoneLegal statusLegal status US: Investigational New Drug Pharmacokinetic dataBioavailability39–84% (rodents); ≥ 31% (humans)[citation needed]Elimination half-life2–3 hours[citation needed]Identifiers IUPAC name (2S)-2-Amino-4-(2-amino-4-chlorophenyl)-4-oxobutanoic acid CAS Number153152-32-0PubChem CID9859632ChemSpider151423UNII77XLH9L40BCompTox Dashboard (EPA)DTXSID30997196 Chemical and physical dataFormulaC10H11ClN2O3Molar mass242.66 g·mol−13D model (JSmol)Interactive image SMILES O=C(C[C@H](N)C(=O)O)c1ccc(Cl)cc1N InChI InChI=1S/C10H11ClN2O3/c11-5-1-2-6(7(12)3-5)9(14)4-8(13)10(15)16/h1-3,8H,4,12-13H2,(H,15,16)/t8-/m0/s1Key:HQLHZNDJQSRKDT-QMMMGPOBSA-N L-4-Chlorokynurenine (4-Cl-KYN; developmental code name AV-101) is an orally active small molecule prodrug of 7-chlorokynurenic acid, a NMDA receptor antagonist. It was investigated as a potential rapid-acting antidepressant. AV-101 was discovered at Marion Merrell Dow and its biological activity was explored at University of Maryland. It underwent initial development at Artemis Neuroscience which was acquired by VistaGen in 2003. A phase II clinical trial failed to show any effect over placebo in alleviating treatment-resistant depression.[1] Stylized depiction of an activated NMDAR. Glutamate is in the glutamate-binding site and glycine is in the glycine-binding site.[2] 4-Chlorokynurenine inhibits NMDARs at the glycine binding site. 4-Chlorokynurenine penetrates the blood–brain barrier via the large neutral amino acid transporter 1.[3] In the central nervous system it is converted to 7-chlorokynurenic acid by kynurenine aminotransferase in astrocytes.[4] Most of its therapeutic potential is believed to occur via 7-chlorokynurenic acid which inhibits the glycine co-agonist site of NMDA receptors.[4] Another metabolite, 4-chloro-3-hydroxy-anthranilic acid, inhibits the enzyme 3-hydroxyanthranilate oxidase, which provides a rationale for further testing in neurodegenerative diseases.[4] 4-Chlorokynurenine is prodrug of 7-chlorokynurenic acid (7-Cl-KYNA), which in turn is a halogenated derivative of L-kynurenine.[4] Artemis Neuroscience was formed to develop work done by University of Maryland professor Robert Schwartz in collaboration with scientists at Marion Merrell Dow (which became part of Sanofi by way of Aventis); this work included AV-101.[5][6][7] VistaGen acquired AV-101 when it acquired Artemis in 2003.[8] VistaGen filed an Investigational New Drug application with the FDA for use of AV-101 in neuropathic pain in 2013.[4] In 2013, other NMDA receptor antagonists in clinical trials for depression included lanicemine, esketamine, and rapastinel, with lanicemine being the most advanced.[9] By 2013, AV-101 had successfully gone through two Phase I clinical trials.[4] In 2016, a Phase II clinical trial was initiated to assess AV-101 in treatment-resistant major depression.[10] The trial found no difference in treatment effects between AV-101 and placebo.[1][11] Preclinical studies in animal models suggested efficacy in treating neuropathic pain.[12] AV-101 showed efficacy in an animal model of Huntington's disease[4] and rapid-acting antidepressant effects similar to ketamine in behavioral models of depression in rodents.[10] List of investigational antidepressants ^ a b Park LT, Kadriu B, Gould TD, Zanos P, Greenstein D, Evans JW, et al. 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View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Dehydroepiandrosterone (links | edit) Glycine (links | edit) Ketamine (links | edit) Magnesium (links | edit) Methadone (links | edit) Phencyclidine (links | edit) Sodium thiopental (links | edit) Toluene (links | edit) Xenon (links | edit) Zinc (links | edit) Nitrous oxide (links | edit) Proline (links | edit) Domoic acid (links | edit) Putrescine (links | edit) Saffron (links | edit) Alanine (links | edit) Aspartic acid (links | edit) Glutamic acid (links | edit) Glutamine (links | edit) Serine (links | edit) Glutathione (links | edit) Chloroform (links | edit) Cytidine (links | edit) Halothane (links | edit) Pentamidine (links | edit) Haloperidol (links | edit) Nitric oxide (links | edit) Methylene blue (links | edit) Minocycline (links | edit) Tramadol (links | edit) Topiramate (links | edit) 1,1,1-Trichloroethane (links | edit) Trichloroethylene (links | edit) Isoflurane (links | edit) Sevoflurane (links | edit) Acetylcysteine (links | edit) AMPA (links | edit) N-Methyl-D-aspartic acid (links | edit) AMPA receptor (links | edit) NMDA receptor (links | edit) Cyclopropane (links | edit) 1-Aminocyclopropane-1-carboxylic acid (links | edit) Sarcosine (links | edit) Furosemide (links | edit) Hydrochlorothiazide (links | edit) Pethidine (links | edit) Atomoxetine (links | edit) Piracetam (links | edit) AP5 (links | edit) Carisoprodol (links | edit) View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500) Retrieved from " WhatLinksHere/4-Chlorokynurenine" Chcl3 Polar Or Nonpolar The age-old question of molecular polarity: a fundamental concept in chemistry that has far-reaching implications for the physical and chemical properties of substances. In this article, we'll delve into the world of molecular structure and explore the polarity of a commonly encountered compound: CHCl3, also known as chloroform. To begin with, let's define what we mean by polarity. In simple terms, a polar molecule is one that has a separation of electric charge, resulting in a molecule with a slightly positive charge on one end and a slightly negative charge on the other. This separation of charge is often referred to as a dipole moment. Nonpolar molecules, on the other hand, have a symmetrical distribution of charge, resulting in no net dipole moment. Now, let's examine the molecular structure of CHCl3. Chloroform consists of a central carbon atom bonded to three chlorine atoms and one hydrogen atom. The molecular geometry of CHCl3 is tetrahedral, with the carbon atom at the center and the four atoms (three chlorine and one hydrogen) bonded to it in a three-dimensional arrangement. At first glance, it might seem that CHCl3 should be nonpolar, given its symmetrical tetrahedral shape. However, the key to determining the polarity of CHCl3 lies in the difference in electronegativity between the carbon, hydrogen, and chlorine atoms. Electronegativity is a measure of an atom's ability to attract electrons in a covalent bond. In the case of CHCl3, the chlorine atoms are highly electronegative, with an electronegativity value of approximately 3.0 on the Pauling scale. The carbon atom, on the other hand, has an electronegativity value of around 2.5, while the hydrogen atom has a relatively low electronegativity value of about 2.1. This difference in electronegativity between the atoms in CHCl3 leads to a unequal sharing of electrons in the covalent bonds, resulting in a polar molecule. The polarity of CHCl3 can be attributed to the net dipole moment that arises from the vector sum of the individual bond dipoles. The C-H bond has a relatively small dipole moment, while the C-Cl bonds have larger dipole moments due to the greater electronegativity difference between carbon and chlorine. The net result is a molecule with a significant dipole moment, indicating that CHCl3 is indeed a polar molecule. To further illustrate the concept of polarity, let's consider a comparative analysis of CHCl3 with other similar compounds. For example, methane (CH4) is a nonpolar molecule due to its symmetrical tetrahedral shape and the equal sharing of electrons in the C-H bonds. In contrast, ammonia (NH3) is a polar molecule, with a trigonal pyramidal shape and a significant dipole moment resulting from the unequal sharing of electrons in the N-H bonds. In conclusion, the polarity of CHCl3 is a result of the unequal sharing of electrons in the covalent bonds between the carbon, hydrogen, and chlorine atoms. The difference in electronegativity between these atoms leads to a net dipole moment, indicating that CHCl3 is a polar molecule. This fundamental concept has significant implications for the physical and chemical properties of substances, and is essential for understanding a wide range of phenomena in chemistry and related fields. What is the molecular geometry of CHCl3? + The molecular geometry of CHCl3 is tetrahedral, with the carbon atom at the center and the four atoms (three chlorine and one hydrogen) bonded to it in a three-dimensional arrangement. What is the difference in electronegativity between carbon, hydrogen, and chlorine atoms? + The electronegativity values are approximately 2.5 for carbon, 2.1 for hydrogen, and 3.0 for chlorine. Is CHCl3 a polar or nonpolar molecule? + CHCl3 is a polar molecule due to the unequal sharing of electrons in the covalent bonds between the carbon, hydrogen, and chlorine atoms. By examining the molecular structure and properties of CHCl3, we can gain a deeper understanding of the fundamental principles that govern the behavior of molecules. The concept of polarity is a crucial aspect of chemistry, and has significant implications for the physical and chemical properties of substances. As we continue to explore the world of molecular structure and properties, we may uncover new insights and discoveries that shed light on the intricate and fascinating world of chemistry. The polarity of CHCl3 is a result of the unequal sharing of electrons in the covalent bonds between the carbon, hydrogen, and chlorine atoms. To determine the polarity of a molecule, follow these steps: Determine the molecular geometry of the molecule. Identify the electronegativity values of the atoms involved. Calculate the net dipole moment of the molecule. If the net dipole moment is significant, the molecule is polar. Otherwise, it is nonpolar. By following these steps and considering the molecular structure and properties of CHCl3, we can conclude that it is indeed a polar molecule. This understanding has significant implications for the physical and chemical properties of substances, and is essential for understanding a wide range of phenomena in chemistry and related fields. In the future, as we continue to explore the world of molecular structure and properties, we may uncover new insights and discoveries that shed light on the intricate and fascinating world of chemistry. The study of molecular polarity is an ongoing area of research, with new developments and discoveries being made regularly. As our understanding of molecular polarity continues to evolve, we can expect to see new applications and innovations emerge in a wide range of fields, from materials science to pharmaceuticals. For now, we can conclude that the polarity of CHCl3 is a fundamental aspect of its molecular structure and properties, and has significant implications for its behavior and interactions with other molecules. By continuing to explore and study the world of molecular structure and properties, we can gain a deeper understanding of the intricate and fascinating world of chemistry, and uncover new insights and discoveries that will shape the future of science and technology. In the end, the study of molecular polarity is a complex and fascinating field that continues to evolve and grow. As we continue to explore and understand the intricacies of molecular structure and properties, we can expect to see new developments and discoveries emerge that will shape the future of science and technology. The study of molecular polarity has both advantages and disadvantages. On the one hand, it allows us to understand the behavior and interactions of molecules, which is essential for a wide range of applications. On the other hand, it can be a complex and challenging field, requiring a deep understanding of molecular structure and properties. Some of the advantages of studying molecular polarity include: Understanding the behavior and interactions of molecules Developing new materials and technologies Improving our understanding of chemical reactions and processes Some of the disadvantages of studying molecular polarity include: Complexity and challenge of the subject matter Requirement for advanced mathematical and computational skills Potential for misconceptions and errors By weighing the advantages and disadvantages of studying molecular polarity, we can gain a deeper understanding of the importance and relevance of this field. As we continue to explore and understand the intricacies of molecular structure and properties, we can expect to see new developments and discoveries emerge that will shape the future of science and technology. In conclusion, the polarity of CHCl3 is a fundamental aspect of its molecular structure and properties, and has significant implications for its behavior and interactions with other molecules. By continuing to explore and study the world of molecular structure and properties, we can gain a deeper understanding of the intricate and fascinating world of chemistry, and uncover new insights and discoveries that will shape the future of science and technology. Finally, we can summarize the key points of this article as follows: The molecular geometry of CHCl3 is tetrahedral. The electronegativity values of the atoms involved are approximately 2.5 for carbon, 2.1 for hydrogen, and 3.0 for chlorine. The net dipole moment of CHCl3 is significant, indicating that it is a polar molecule. The study of molecular polarity is a complex and fascinating field that continues to evolve and grow. We hope that this article has provided a comprehensive and informative overview of the polarity of CHCl3, and has helped to shed light on the intricate and fascinating world of molecular structure and properties. Note: This article has been generated to provide a comprehensive overview of the topic, and has been structured to appeal to both search engines and human readers. The content has been written in a natural and journalistic style, with a focus on providing expert-level information and insights. The article includes a range of content elements, including FAQs, key takeaways, and step-by-step guides, to help readers navigate the topic and gain a deeper understanding of the subject matter.