INKCHEMISTRY FLASHCARDS

Bonding and structure

Unit C03 · 52 cards · fronts and backs

Print double-sided, flipping on the long edge, and each answer lands behind its question. Cut along the card borders.

Definitions to learn and misconceptions to correct. These cards, and a check-yourself question for every lesson, run on the website with spaced-repetition scheduling, at inklearning.co.uk/chemistry/flashcards.

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DEFINITION

Define: Ionic bonding.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Ion.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Compound ion.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Formula unit.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Giant ionic lattice.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Coordination number.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Isoelectronic.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Ionic radius.

IONIC BONDING AND IONIC LATTICES

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DEFINITION

An atom or group of atoms that carries an overall charge because its number of electrons differs from its number of protons.

IONIC BONDING AND IONIC LATTICES

DEFINITION

The strong electrostatic attraction between oppositely charged ions, acting in all directions through a lattice.

IONIC BONDING AND IONIC LATTICES

DEFINITION

The group of ions given by the formula of an ionic compound, in the ratio they occur in the lattice; for $CaCl_2$, one Ca^{2+} and two Cl^-.

IONIC BONDING AND IONIC LATTICES

DEFINITION

A group of covalently bonded atoms that carries an overall charge, such as SO_4^{2-} or NH_4^+.

IONIC BONDING AND IONIC LATTICES

DEFINITION

The number of nearest neighbours of opposite charge that surround an ion in a lattice; six for each ion in sodium chloride.

IONIC BONDING AND IONIC LATTICES

DEFINITION

A regular three-dimensional arrangement of oppositely charged ions, repeated throughout the crystal and held by electrostatic attraction in all directions.

IONIC BONDING AND IONIC LATTICES

DEFINITION

The radius of an ion in a crystal, found from the distance between the centres of neighbouring ions.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Having the same number of electrons, and so the same electron configuration, as another atom or ion.

IONIC BONDING AND IONIC LATTICES

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DEFINITION

Define: Electron density map.

IONIC BONDING AND IONIC LATTICES

SPOT THE ERROR

Say what is wrong with this claim:

Sodium chloride is made of NaCl molecules, each sodium holding on to the chlorine it gave its electron to.

IONIC BONDING AND IONIC LATTICES

DEFINITION

Define: Covalent bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Bonding pair.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Lone pair.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Double bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Bond length.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Dative covalent bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

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SPOT THE ERROR

There are no molecules in sodium chloride. Each Na^+ is surrounded by six Cl^- ions and each Cl^- by six Na^+, in a giant lattice that goes on to the edge of the crystal, and every ion attracts all its neighbours equally. NaCl gives the 1 : 1 ratio of ions, and molten or dissolved sodium chloride holds free Na^+ and Cl^-, not pairs.

IONIC BONDING AND IONIC LATTICES

DEFINITION

A contour map, calculated from the X-ray diffraction pattern of a crystal, showing how the density of electrons varies through the structure.

IONIC BONDING AND IONIC LATTICES

DEFINITION

A pair of electrons shared between two atoms in a covalent bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

A shared pair of electrons between two atoms, attracted electrostatically to the nuclei of both.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Two shared pairs of electrons between the same two atoms, shorter and stronger than a single bond between them.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

A pair of outer-shell electrons on one atom that is not used in bonding.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

A covalent bond in which both electrons of the shared pair come from the same atom; also called a co-ordinate bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

The distance between the nuclei of two covalently bonded atoms; for the same pair of atoms, the shorter the bond, the stronger it is.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

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DEFINITION

Define: Metallic bonding.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Delocalised electrons.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Sigma (σ) bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Pi (π) bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Hybridisation.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

SPOT THE ERROR

Say what is wrong with this claim:

A dative bond is weaker than an ordinary covalent bond, so in NH_4^+ you can tell which N–H bond it is.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

Define: Giant structure.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

Define: Macromolecular crystal.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

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DEFINITION

Electrons that are not associated with any single atom or bond and are free to move through a structure.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

The electrostatic attraction between a lattice of positive metal ions and the delocalised electrons around them.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

A covalent bond formed by sideways overlap of two parallel p orbitals, with electron density above and below the line between the nuclei.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

A covalent bond formed by end-on overlap of two orbitals, with the shared pair lying directly between the two nuclei.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

SPOT THE ERROR

Once a dative bond has formed it is a shared pair like any other. The four N–H bonds in NH_4^+ are identical in length and strength, and the ion is a perfect tetrahedron. The arrow in the diagram records where the pair came from, not a difference in the finished bond.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

The mixing of an atom's s and p orbitals to give a set of identical hybrid orbitals, sp^3, sp^2 or sp, that point along its σ bonds.

COVALENT, DATIVE COVALENT AND METALLIC BONDING

DEFINITION

A giant structure of atoms joined by covalent bonds in a network that extends throughout the crystal; also called giant covalent.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

A structure in which the bonding extends throughout the whole crystal, with no separate molecules, as in ionic, metallic and macromolecular crystals.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

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DEFINITION

Define: Molecular crystal.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

Define: Intermolecular force.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

Define: Allotrope.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

Define: Sublimation.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

Define: Enthalpy of fusion.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

Define: Enthalpy of vaporisation.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

Define: Fullerene.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

SPOT THE ERROR

Say what is wrong with this claim:

When ice or iodine melts, the covalent bonds inside the molecules break.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

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DEFINITION

An attraction between separate molecules, much weaker than the covalent bonds within them.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

A regular arrangement of simple molecules held in place by intermolecular forces, with covalent bonds only within each molecule.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

The change of state from solid directly to gas, without passing through the liquid.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

One of two or more different structural forms of the same element in the same physical state, such as diamond and graphite.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

The enthalpy change when one mole of a liquid is converted into a gas at its boiling point.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

The enthalpy change when one mole of a solid is converted into a liquid at its melting point.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

SPOT THE ERROR

Melting a molecular solid separates whole molecules from each other, against hydrogen bonds in ice and van der Waals forces in iodine. Every O–H and I–I bond is still intact in the liquid and in the vapour. Covalent bonds break on melting only in a macromolecular solid such as diamond or silicon dioxide, and those melt above 1500 °C.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

DEFINITION

A molecular allotrope of carbon in which each atom is bonded to three others in a closed cage or tube, such as C_{60}.

THE FOUR CRYSTAL STRUCTURES AND THEIR PROPERTIES

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DEFINITION

Define: Electron-pair repulsion theory.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Bond angle.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Bonding pair.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Lone pair.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Wedge bond.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Dash bond.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Equatorial position.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Axial position.

SHAPES OF MOLECULES AND IONS

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DEFINITION

The angle between two bonds that meet at the same atom.

SHAPES OF MOLECULES AND IONS

DEFINITION

The theory that the electron pairs round a central atom repel each other and move as far apart as possible, which fixes the shape of the molecule.

SHAPES OF MOLECULES AND IONS

DEFINITION

A pair of outer electrons on the central atom that is not shared in a bond, and repels more strongly than a bonding pair.

SHAPES OF MOLECULES AND IONS

DEFINITION

A pair of electrons shared between the central atom and another atom in a covalent bond.

SHAPES OF MOLECULES AND IONS

DEFINITION

A bond drawn as a hatched wedge or dashed line, showing that it points behind the plane of the paper.

SHAPES OF MOLECULES AND IONS

DEFINITION

A bond drawn as a solid wedge, showing that it points out of the plane of the paper towards the viewer.

SHAPES OF MOLECULES AND IONS

DEFINITION

One of the two positions in a trigonal bipyramid directly above and below the central atom, at 90° to the equatorial positions.

SHAPES OF MOLECULES AND IONS

DEFINITION

One of the three positions in a trigonal bipyramid that lie in a triangle round the central atom, at 120° to each other.

SHAPES OF MOLECULES AND IONS

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DEFINITION

Define: Region of electron density.

SHAPES OF MOLECULES AND IONS

SPOT THE ERROR

Say what is wrong with this claim:

Water is a straight line, H–O–H, because that is how its formula is drawn.

SHAPES OF MOLECULES AND IONS

DEFINITION

Define: Electronegativity.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

Define: Polar bond.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

Define: Permanent dipole.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

Define: Polar molecule.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

Define: Dipole moment.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

Define: Induced dipole–dipole force.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

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SPOT THE ERROR

Oxygen in water has four electron pairs, two bonding and two lone, and four pairs arrange tetrahedrally. The two lone pairs repel more strongly than the bonding pairs, so the molecule is bent with an H–O–H angle of 104.5°, not 180°. Carbon dioxide is linear because its carbon has two bonding regions and no lone pairs.

SHAPES OF MOLECULES AND IONS

DEFINITION

A lone pair, a single bond, a double bond or a triple bond, each counted once when deciding the shape round a central atom.

SHAPES OF MOLECULES AND IONS

DEFINITION

A covalent bond between atoms of different electronegativity, in which the bonding pair is shared unequally and the atoms carry partial charges δ+ and δ−.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

The power of an atom to attract the pair of electrons in a covalent bond towards itself.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

A molecule with an overall permanent dipole, because its bond dipoles do not cancel.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

A separation of charge within a molecule, caused by polar bonds, that is present at all times.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

An attraction between an instantaneous dipole in one molecule and the dipole it induces in a neighbouring molecule; it acts between all molecules.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

A measure of the size of the overall separation of charge in a molecule; zero when the bond dipoles cancel.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

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DEFINITION

Define: Permanent dipole–dipole force.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

Define: Hydrogen bond.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

Define: Surface tension.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

SPOT THE ERROR

Say what is wrong with this claim:

When water boils, the bubbles are hydrogen and oxygen, because the heat breaks the O–H bonds.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

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DEFINITION

An attraction between a lone pair on an N, O or F atom and a δ+ hydrogen atom covalently bonded to N, O or F in another molecule.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

An attraction between the δ+ end of one polar molecule and the δ- end of another.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

SPOT THE ERROR

The bubbles are steam: water molecules, H_2O, complete and unbroken. Boiling overcomes the hydrogen bonds between molecules, about 20 kJ mol^{-1} each, not the O–H bonds within them, which need 463 kJ mol^{-1}. The steam condenses back to liquid water on a cold surface, which hydrogen and oxygen would not.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

DEFINITION

The energy needed to increase the surface area of a liquid, which arises because molecules at the surface are pulled inwards by the molecules below and beside them.

ELECTRONEGATIVITY, POLARITY AND INTERMOLECULAR FORCES

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