INKCHEMISTRY FLASHCARDS

Aromatic chemistry and amines

Unit C21 · 43 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: Kekulé structure.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Delocalised electrons.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Delocalised model of benzene.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Arene.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Enthalpy of hydrogenation.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Delocalisation energy.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Phenyl group.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Phenol.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

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DEFINITION

Electrons that are shared between more than two atoms and are not fixed in one bond.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

A model of benzene as a ring of six carbon atoms joined by alternating single and double bonds, cyclohexa-1,3,5-triene.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

A hydrocarbon containing one or more benzene rings; compounds containing a benzene ring are called aromatic.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

A planar ring of six carbon atoms joined by σ bonds, in which a p orbital on each carbon overlaps with those on both neighbours, giving a ring of six delocalised electrons above and below the plane.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

The difference in energy between benzene and the Kekulé structure, 152 kJ mol^{-1}, by which the delocalised ring is more stable; also called resonance energy.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

The enthalpy change when one mole of an unsaturated compound reacts completely with hydrogen to give a saturated compound.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

A compound with an OH group bonded directly to a benzene ring; also the name of the simplest, C_6H_5OH.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

The $C_6H_5–$ group, a benzene ring with one hydrogen atom removed, attached to the rest of a molecule.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

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DEFINITION

Define: Phenoxide ion.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Halogenoarene.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

SPOT THE ERROR

Say what is wrong with this claim:

Benzene has three double bonds that keep swapping places, so each bond is a double bond half of the time.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

Define: Electrophile.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Electrophilic substitution.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Nitronium ion.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Acylium ion.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Halogen carrier.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

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DEFINITION

A compound in which a halogen atom is bonded directly to a carbon atom of a benzene ring, such as chlorobenzene.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

The ion $C_6H_5O^-$ formed when phenol loses a proton, its negative charge delocalised into the ring.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

An electron pair acceptor: a species that accepts a pair of electrons to form a new covalent bond.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

SPOT THE ERROR

Benzene has no double bonds at any moment. All six carbon–carbon bonds are 140 pm, between a single and a double bond, and six electrons are delocalised in a ring of p orbitals above and below the plane. Hydrogenating benzene releases 152 kJ mol^{-1} less than three separate C=C would, which measures the extra stability delocalisation gives.

BENZENE: ITS STRUCTURE AND THE EVIDENCE FOR DELOCALISATION

DEFINITION

The electrophile in nitration, NO_2^+, formed when concentrated sulfuric acid protonates nitric acid, which then loses water.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

A reaction in which an electrophile replaces an atom, usually hydrogen, on an electron-rich compound such as benzene.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

A compound such as $AlCl_3$ that accepts a lone pair from a halogen atom and so generates a positive electrophile.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

The electrophile in Friedel–Crafts acylation, RCO^+, with the positive charge on the carbonyl carbon.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

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DEFINITION

Define: Friedel–Crafts acylation.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Friedel–Crafts alkylation.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Activating group.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Deactivating group.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

SPOT THE ERROR

Say what is wrong with this claim:

Benzene reacts like an alkene, so the nitro group adds across one of its double bonds.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

Define: Primary amine.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Secondary amine.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Tertiary amine.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

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DEFINITION

The electrophilic substitution of an alkyl group onto a benzene ring, using a halogenoalkane and an aluminium chloride catalyst.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

The electrophilic substitution of an acyl group, RCO, onto a benzene ring, using an acyl chloride and an aluminium chloride catalyst, giving a ketone.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

A group that withdraws electron density from a benzene ring, so that the ring reacts with electrophiles more slowly than benzene; NO_2, COOH and COR direct to position 3.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

A group that releases electron density into a benzene ring, so that the ring reacts with electrophiles faster than benzene; OH, NH_2 and alkyl groups direct to positions 2, 4 and 6.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

An amine in which the nitrogen atom is bonded to one carbon group, RNH_2.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

SPOT THE ERROR

Addition would end the delocalised ring and lose its stability, so benzene substitutes instead. NO_2^+ takes a pair of electrons from the ring and bonds to one carbon; the ring then loses the H^+ from that carbon and restores its six delocalised electrons. The product, nitrobenzene, is still aromatic, which an addition product would not be.

ELECTROPHILIC SUBSTITUTION: NITRATION AND FRIEDEL–CRAFTS ACYLATION

DEFINITION

An amine in which the nitrogen atom is bonded to three carbon groups, R_3N.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

An amine in which the nitrogen atom is bonded to two carbon groups, R_2NH.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

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DEFINITION

Define: Quaternary ammonium salt.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Cationic surfactant.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Positive inductive effect.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Nucleophile.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Diazonium ion.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Azo compound.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

SPOT THE ERROR

Say what is wrong with this claim:

Phenylamine has a bigger group on the nitrogen than methylamine, so it should be the stronger base.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

Define: Amino acid.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

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DEFINITION

A quaternary ammonium salt with a long hydrocarbon chain, whose positive head is attracted to negatively charged surfaces such as fabric and hair.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

An ionic compound containing a nitrogen atom bonded to four carbon groups and carrying a positive charge, R_4N^+, with a negative ion.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

An electron pair donor: a species with a lone pair of electrons that it donates to an electron-deficient atom to form a covalent bond.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

The release of electron density by an alkyl group towards the atom it is bonded to.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

A compound in which two benzene rings are joined by an –N=N– group, made by coupling a diazonium ion with a phenol or an aromatic amine.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

An ion containing the $-N_2^+$ group bonded to a benzene ring, such as $C_6H_5N_2^+$, made from an aromatic amine and nitrous acid below 10 °C.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

DEFINITION

A compound with an amine group and a carboxylic acid group; in the α-amino acids that make proteins both are on the same carbon atom.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

SPOT THE ERROR

Base strength depends on how available the lone pair is. A methyl group releases electron density onto the nitrogen, so methylamine is a stronger base than ammonia. In phenylamine the lone pair is partly delocalised into the benzene ring, so it is less available and phenylamine is weaker than ammonia.

AMINES: PREPARATION, BASICITY AND NUCLEOPHILIC REACTIONS

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DEFINITION

Define: Zwitterion.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Isoelectric point.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Peptide link.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Primary structure.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Secondary structure.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Tertiary structure.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Active site.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Stereospecific active site.

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DEFINITION

The pH at which an amino acid exists as the zwitterion and has no overall charge.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

An ion with both a positive and a negative charge and no overall charge, as in $^{+}H_3NCH(R)COO^{-}$.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

The sequence of amino acids in a polypeptide chain.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

The –CONH– group that joins two amino acids, formed by a condensation reaction that eliminates water.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

The folding of the whole polypeptide chain into a three-dimensional shape, held by hydrogen bonds, ionic bonds and disulfide bridges between side chains.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

The coiling of a polypeptide chain into an α-helix or its folding into a β-pleated sheet, held by hydrogen bonds between peptide links.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

An active site that can bond to only one enantiomeric form of a substrate or drug, because the site itself is chiral.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

The region of an enzyme, formed by its tertiary structure, to which the substrate binds and where the reaction is catalysed.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

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DEFINITION

Define: Nucleotide.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

Define: Electrophoresis.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

SPOT THE ERROR

Say what is wrong with this claim:

An amino acid is an acid, so a solution of glycine must be acidic, and solid glycine is a molecular solid like ethanoic acid.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

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DEFINITION

The separation of charged species, such as amino acids in a buffer of fixed pH, by their movement towards the oppositely charged electrode when a potential difference is applied.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

DEFINITION

The monomer of DNA, made of a phosphate group, the sugar 2-deoxyribose and one of four bases.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

SPOT THE ERROR

Glycine carries a base as well, and its COOH donates a proton to its own NH_2. In the solid it exists as the zwitterion $^{+}H_3NCH_2COO^{-}$, held in an ionic lattice, so it is a crystalline solid that decomposes above 230 °C rather than melting. In water the zwitterion dominates near pH 6, and the solution is close to neutral.

AMINO ACIDS, PROTEINS, ENZYMES AND DNA

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