INKCHEMISTRY FLASHCARDS

Organic synthesis

Unit C22 · 35 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: Synthetic route.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Reagent.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Conditions.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Intermediate.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Retrosynthesis.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Overall yield.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Atom economy.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Hazard.

PLANNING A SYNTHETIC ROUTE

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DEFINITION

The substance added to bring about a reaction, named in full or by a correct formula.

PLANNING A SYNTHETIC ROUTE

DEFINITION

A sequence of reactions that converts a starting material into a target compound, with the reagents and conditions for each step.

PLANNING A SYNTHETIC ROUTE

DEFINITION

A compound made in one step of a synthesis and used as the starting material for the next.

PLANNING A SYNTHETIC ROUTE

DEFINITION

The temperature, solvent, catalyst and method of heating a reaction needs to give the intended product.

PLANNING A SYNTHETIC ROUTE

DEFINITION

The yield of a route of several steps, found by multiplying the fractional yields of the individual steps together.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Planning a synthesis by working backwards from the target, asking at each stage which compound could give it in a single step.

PLANNING A SYNTHETIC ROUTE

DEFINITION

A property of a substance or procedure that could cause harm, such as toxicity, flammability or corrosiveness.

PLANNING A SYNTHETIC ROUTE

DEFINITION

The mass of the desired product divided by the total mass of the reactants, multiplied by 100, from the balanced equation.

PLANNING A SYNTHETIC ROUTE

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DEFINITION

Define: Risk.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Racemic mixture.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Grignard reagent.

PLANNING A SYNTHETIC ROUTE

SPOT THE ERROR

Say what is wrong with this claim:

A synthesis question is a memory test: either the route was in my notes or I have no way in.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Define: Heating under reflux.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Distillation.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Recrystallisation.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Filtration under reduced pressure.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

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DEFINITION

An equimolar mixture of the two enantiomers of a chiral compound, which has no overall effect on plane-polarised light.

PLANNING A SYNTHETIC ROUTE

DEFINITION

The chance that a hazard causes harm as the substance is actually used, which precautions such as a fume cupboard reduce.

PLANNING A SYNTHETIC ROUTE

SPOT THE ERROR

A route is built from known reactions by working backwards. Ask which reaction makes the target's functional group; that names the compound one step before, and the question repeats until a starting material appears. Count carbons too: if the target has one more, a nitrile from KCN and a halogenoalkane is the usual way in.

PLANNING A SYNTHETIC ROUTE

DEFINITION

An organomagnesium halide, RMgX, made from a halogenoalkane and magnesium in dry ether, whose carbon bonded to magnesium acts as a nucleophile and forms a new C–C bond.

PLANNING A SYNTHETIC ROUTE

DEFINITION

Separating a liquid from a mixture by boiling it and condensing the vapour in a separate vessel, collected at its boiling point.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Heating a reaction mixture with a vertical condenser so that volatile substances condense and return to the flask, allowing prolonged heating without loss.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Filtration through a Büchner funnel with a pump lowering the pressure in the flask below, which is faster and leaves a drier solid.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Purifying a solid by dissolving it in the minimum volume of hot solvent, cooling so the product crystallises while impurities stay in solution, then filtering, washing and drying.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

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DEFINITION

Define: Melting point of a pure solid.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Immiscible.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Drying agent.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Boiling temperature.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Percentage yield.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Steam distillation.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

SPOT THE ERROR

Say what is wrong with this claim:

Recrystallising just means letting the product crystallise again, so the more solvent I use to dissolve it, the cleaner it comes out.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Define: Empirical formula.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

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DEFINITION

Describes two liquids that do not mix and form two separate layers.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

The single temperature, reached sharply, at which a pure solid turns to liquid; impurities lower it and widen the range.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

The temperature at which the vapour pressure of a liquid equals atmospheric pressure; a pure liquid distils at a steady temperature matching its data-book value.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

An anhydrous salt, such as magnesium sulfate or calcium chloride, that removes water from an organic liquid by absorbing it as water of crystallisation.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

Distilling an organic liquid that is immiscible with water together with steam, so that it distils below 100 °C, well below its own boiling point.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

The actual mass of product obtained divided by the theoretical mass from the limiting reactant, multiplied by 100.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

DEFINITION

The simplest whole-number ratio of the atoms of each element in a compound.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

SPOT THE ERROR

Use the minimum of hot solvent that just dissolves the crude solid. Purity comes from the impurities staying dissolved while the product crystallises on cooling. Extra solvent keeps more product dissolved too, so it passes through the filter and the yield falls. Cooling in ice before filtering recovers more of it.

PREPARING, PURIFYING AND TESTING AN ORGANIC SOLID AND LIQUID

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DEFINITION

Define: Molecular ion.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: Degree of unsaturation.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: Fingerprint region.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: Chemical shift.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: Chemical environment.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: Integration ratio.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: N + 1 rule.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: Equivalent atoms.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

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DEFINITION

The number of rings plus double bonds in a molecule, found from (2C + 2 + N − H − X) ÷ 2, where a triple bond counts as two.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

The ion formed when a molecule loses one electron, M^+; its m/z gives the relative molecular mass.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

The position of an NMR peak, δ in ppm, measured relative to TMS at 0 ppm; it depends on the atom's chemical environment.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

The part of an infrared spectrum below 1500 cm^{-1}, whose pattern is unique to a compound and identifies it by comparison with a database.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

The ratio of the areas under the peaks of a proton NMR spectrum, equal to the ratio of the numbers of hydrogens in each environment.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

A set of atoms that are bonded to identical surroundings, so they absorb at the same chemical shift and give one peak.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Atoms that are interchanged by the symmetry of the molecule, so they share an environment and give a single NMR peak.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

A proton NMR peak is split into n + 1 lines, where n is the number of hydrogens on the adjacent carbon atoms.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

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DEFINITION

Define: External calibration.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Define: D_2O exchange.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

SPOT THE ERROR

Say what is wrong with this claim:

If the carbon-13 spectrum has the right number of peaks, I have found the structure.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

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DEFINITION

Shaking a sample with D_2O replaces the hydrogen of O–H and N–H groups with deuterium, so their proton NMR peak disappears.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

DEFINITION

Finding a concentration by measuring standards of known concentration, plotting the response against concentration, and reading the unknown from the graph.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

SPOT THE ERROR

A carbon-13 count gives the number of carbon environments, and several isomers can share it: propan-1-ol and methoxyethane both give three peaks. The structure is settled by combining the molecular formula, the infrared absorptions and the proton environments with their integration and splitting.

PUTTING THE ANALYSIS TOGETHER: STRUCTURE FROM SPECTRA

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