INKCHEMISTRY FLASHCARDS

Energetics

Unit C04 · 39 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: Enthalpy change, ΔH.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Exothermic.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Endothermic.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Activation energy.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Kinetically stable.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Standard conditions.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Standard state.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Standard enthalpy of formation, $\Delta_f H^\circ$.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

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DEFINITION

Describes a reaction in which heat energy is transferred to the surroundings, so ΔH is negative.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

The heat energy change measured under conditions of constant pressure.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

The minimum energy that particles must have for a reaction to take place when they collide.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Describes a reaction in which heat energy is taken in from the surroundings, so ΔH is positive.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

A pressure of 100 kPa and a stated temperature, usually 298 K, with any solutions at 1.00 mol dm^{-3}.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Describes a mixture that does not react at a measurable rate because its activation energy is high, even though ΔH for its reaction is negative.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

The enthalpy change when one mole of a compound is formed from its constituent elements, with all reactants and products in their standard states under standard conditions.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

The physical state of a substance at 100 kPa and 298 K, such as $H_2O(l)$, $O_2(g)$ and C(graphite).

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

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DEFINITION

Define: Standard enthalpy of combustion, $\Delta_c H^\circ$.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Standard enthalpy of neutralisation, $\Delta_{neut} H^\circ$.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Standard enthalpy of reaction, $\Delta_r H^\circ$.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

SPOT THE ERROR

Say what is wrong with this claim:

The beaker got hot, so the reaction gained energy and ΔH must be positive.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

Define: Calorimetry.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Define: Specific heat capacity, c.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Define: Limiting reagent.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Define: Extrapolated temperature rise.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

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DEFINITION

The enthalpy change when solutions of an acid and an alkali react together under standard conditions to produce one mole of water.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

The enthalpy change when one mole of a substance is burned completely in oxygen, with all reactants and products in their standard states under standard conditions.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

SPOT THE ERROR

ΔH is the enthalpy change of the chemicals, not of the beaker. A beaker that gets hot has received energy from the reaction, so the reacting system has lost it: the reaction is exothermic and ΔH is negative. A reaction that makes its beaker colder, such as ammonium nitrate dissolving, has a positive ΔH.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

The enthalpy change when the amounts of reactants shown in the equation react under standard conditions, with all substances in their standard states.

ENTHALPY CHANGE, STANDARD CONDITIONS AND THE DEFINITIONS

DEFINITION

The energy needed to raise the temperature of 1 g of a substance by 1 K.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

The measurement of the heat energy transferred in a reaction from the temperature change of a known mass of water or solution.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

The temperature change read at the time of mixing from a cooling line extended backwards, which corrects for heat lost to the surroundings during the reaction.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

The reactant that is completely used up, which fixes the amount of product formed and the heat released.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

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DEFINITION

Define: Strong acid.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Define: Weak acid.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Define: Incomplete combustion.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Define: Bomb calorimeter.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

SPOT THE ERROR

Say what is wrong with this claim:

The mass in $q = mc\Delta T$ is the mass of the chemical that reacted, because that is what gave out the heat.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Define: Hess's law.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Define: Enthalpy cycle.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Define: Enthalpy of formation of an element.

HESS'S LAW AND ENTHALPY CYCLES

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DEFINITION

An acid that is only partially dissociated into ions in aqueous solution.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

An acid that is completely dissociated into ions in aqueous solution.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

A sealed steel vessel in which a sample burns completely in pure oxygen, surrounded by a known mass of water, so that almost no heat is lost.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Combustion in a limited supply of oxygen, giving carbon monoxide or carbon as well as or instead of carbon dioxide, and releasing less energy.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

The enthalpy change for a reaction is independent of the route taken, provided the initial and final conditions are the same.

HESS'S LAW AND ENTHALPY CYCLES

SPOT THE ERROR

m is the mass of whatever was warmed, which is the solution in the cup, and c is its specific heat capacity, taken as water's, 4.18 J g^{-1} K^{-1}. The reacting chemical gave out the heat; the solution received it, and it is the solution whose temperature rose. The amount that reacted comes in later, when q is divided by moles to give ΔH.

MEASURING AN ENTHALPY CHANGE: CALORIMETRY

DEFINITION

Zero for an element in its standard state, because forming the element from itself involves no change.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

A diagram showing two or more routes between the same reactants and products, with the enthalpy change for each step, used to calculate an unknown enthalpy change.

HESS'S LAW AND ENTHALPY CYCLES

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DEFINITION

Define: Water of crystallisation.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Define: Anhydrous.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Define: Enthalpy of solution.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Define: Thermal decomposition.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Define: Indirect determination.

HESS'S LAW AND ENTHALPY CYCLES

SPOT THE ERROR

Say what is wrong with this claim:

To find an enthalpy change you have to carry out that reaction and measure it.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Define: Bond dissociation enthalpy.

MEAN BOND ENTHALPIES

DEFINITION

Define: Covalent bond.

MEAN BOND ENTHALPIES

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DEFINITION

Describes a salt with no water of crystallisation, such as white $CuSO_4(s)$.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Water molecules held in fixed proportion within the crystal lattice of a hydrated salt.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

The breaking down of a compound into simpler substances by heating it.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

The enthalpy change when one mole of a solute dissolves in enough solvent that further dilution causes no further heat change.

HESS'S LAW AND ENTHALPY CYCLES

SPOT THE ERROR

Hess's law says the enthalpy change is the same by any route between the same reactants and products. So a reaction that cannot be run cleanly, such as forming methane from carbon and hydrogen, is found from reactions that can: burn the reactants, burn the products, and subtract. Most tabulated enthalpies were found this way.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

Finding an enthalpy change that cannot be measured directly by combining, in a Hess cycle, enthalpy changes that can be measured.

HESS'S LAW AND ENTHALPY CYCLES

DEFINITION

The strong electrostatic attraction between a shared pair of electrons and the nuclei of the two bonded atoms.

MEAN BOND ENTHALPIES

DEFINITION

The enthalpy change when one mole of a specified covalent bond is broken, with reactants and products in the gaseous state.

MEAN BOND ENTHALPIES

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DEFINITION

Define: Homolytic fission.

MEAN BOND ENTHALPIES

DEFINITION

Define: Mean bond enthalpy.

MEAN BOND ENTHALPIES

DEFINITION

Define: Enthalpy of atomisation.

MEAN BOND ENTHALPIES

DEFINITION

Define: Bond length.

MEAN BOND ENTHALPIES

DEFINITION

Define: Radical.

MEAN BOND ENTHALPIES

DEFINITION

Define: Enthalpy of vaporisation.

MEAN BOND ENTHALPIES

SPOT THE ERROR

Say what is wrong with this claim:

Breaking bonds releases energy, which is where the heat of a fuel comes from.

MEAN BOND ENTHALPIES

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DEFINITION

The enthalpy needed to break one mole of a given type of covalent bond in the gaseous state, averaged over a range of different compounds.

MEAN BOND ENTHALPIES

DEFINITION

The breaking of a covalent bond so that each atom takes one electron from the shared pair, forming two radicals.

MEAN BOND ENTHALPIES

DEFINITION

The distance between the nuclei of two atoms joined by a covalent bond.

MEAN BOND ENTHALPIES

DEFINITION

The enthalpy change when one mole of gaseous atoms is formed from an element in its standard state.

MEAN BOND ENTHALPIES

DEFINITION

The enthalpy change when one mole of a liquid is converted into a gas at the same temperature.

MEAN BOND ENTHALPIES

DEFINITION

A species with an unpaired electron, such as a hydrogen or chlorine atom formed by homolytic fission.

MEAN BOND ENTHALPIES

SPOT THE ERROR

Breaking a bond always takes energy in; it is making bonds that gives energy out. A fuel is exothermic because the C=O and O–H bonds formed in the products are stronger, in total, than the C–H, C–C and O=O bonds broken in the reactants. $\Delta H = \Sigma(\text{bonds broken}) - \Sigma(\text{bonds made})$, and for a fuel the second term is the larger.

MEAN BOND ENTHALPIES

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