ATOMS: CANNOT BE BROKEN DOWN INTO CONSTITUENTS BY CHEMICAL MEANS (ELEMENT)
COMPOUND: TWO OR MORE TYPES OF ATOMS CHEMICALLY BONDED
MIXTURE: DIFFERENT ATOMS/COMPOUNDS NOT CHEMICALLY BONDED

SEPARATION TECHNIQUES:
- CHROMATOGRAPHY (PRAC!)
filter paper, dot of mixture, e.g. ink → water
- Capillary action draws water up paper, taking particles too. Lighter particles end up higher.

*Rf value = solute d(ink) / solvent d(water)

DISTILLATION: REMOVES SOLUTE FROM SOLVENT
e.g. SALT, WATER.
MIXTURE/SOLUTION HEATED. WATER EVAPORATES, THEN CONDENSES, LEAVING SOLUTE BEHIND.

- FILTRATION: REMOVES INSOLUBLE PARTICLES e.g. SAND
- filter paper

ATOMIC STRUCTURE:
ELECTRON (-1), NUCLEUS, PROTON (+1), NEUTRON (0)
ATOMS HAVE P=E, SO ARE NEUTRAL. IONS HAVE LOST OR GAINED ELECTRONS
CHEM SYMBOL: MASS NUMBER = #p+#n. e.g. $^{4}_{2}He$ ← #protons (=#electrons) 'ATOMIC NUMBER'
ELECTRON CONFIG: 2,8,8,2. e.g. $^{35}_{17}Cl$ 17 ELECTRONS: 2,8,7

ATOMS

PERIODIC TABLE (OF ELEMENTS)
#ELECTRONS IN OUTER SHELL → GROUP
#SHELLS → PERIOD

	1	2	3	4	5	6	7	8(0)
2	Li							He
3	Na	Mg						
4	K							
5					C	N	O	F
6							S	Cl
								Br
								I

TRANSITION METALS (HIGH MELTING POINTS)
NON METALS ("ELECTRON ACCEPTERS")
METALS ("ELECTRON DONATERS")

GROUP 1: ALKALI METALS. GET MORE REACTIVE ↓ AS OUTER ELECTRON IS FURTHER FROM NUCLEUS. REACT W/WATER TO MAKE ALKALI SOLN.
GROUP 7: HALOGENS. LESS REACTIVE ↓ AS OUTER SHELL FURTHER FROM NUCLEUS, ELECTRON NOT ACCEPTED AS EASILY.
GROUP 8: NOBLE GASES. VERY UNREACTIVE DUE TO FULL OUTER SHELLS.

*DEVELOPING PERIODIC TABLE:
- DALTON FIRST PUT ELEMENTS IN 'WEIGHT' ORDER.
- NEWLANDS GROUPED ELEMENTS WITH SIMILAR PROPERTIES TOGETHER (EVERY 8TH)
- MENDELEEV PUT ELEMENTS IN COLUMNS + ROWS ✓

*DEVELOPING ATOMIC MODEL:
- THOMPSON - PLUM PUDDING
- RUTHERFORD - NUCLEUS SMALL + POSITIVE (MAJORITY OF ALPHA PARTICLES WENT THROUGH)
- BOHR - ELECTRON SHELLS

ATOMS 'WANT' A FULL OUTER SHELL: 8 (H and He: 2) OR EMPTY " " : 0

*IONIC (METAL + NON-METAL): METAL DONATES ELECTRON(S) LEAVING A +ve ION, NON-METAL ACCEPTS. CHARGE MUST = 0.
- FORMS A LATTICE (GRID) OF IONS.
e.g. MAGNESIUM CHLORIDE Mg^{2+} Cl^{-} → $MgCl_2$ ← NEEDED SO CHARGES BALANCE
DOT + CROSS: $[Mg]^{2+}[Cl]^{-}_{2}$ ↖ METAL ALWAYS EMPTY ↑ NON-METAL ALWAYS FULL.
HIGH MELTING/BOILING POINTS. SOLUBLE IN WATER. CONDUCTS ELECTRICITY WHEN MOLTEN OR IN SOLUTION, AS IONS ARE FREE TO MOVE.

*COVALENT (NON-METALS) SHARE ELECTRONS TO GET FULL OUTER SHELL.
#ELECTRONS NEEDED = #COVALENT BONDS FORMED.
USUALLY MAKES SMALL MOLECULES (SIMPLE)
e.g. CH_4 (methane) LOW BOILING POINTS.
H MAKES 1 BOND, C (USUALLY): 4. CHECK! ARE SHELLS FULL?
DOT + CROSS:
CO_2
$O=C=O$

BONDING
COVALENT BOND. (x2 ELECTRON PAIR!)

*GIANT COVALENT
e.g. DIAMOND: 3D 'PYRAMID' THAT REPEATS UNTIL YOU HAVE ONE GIANT MOLECULE.
CAN CONDUCT ELECTRICITY
GRAPHITE: LAYERS OF HEXAGONAL ARRANGED ATOMS. 3 BONDS?! 'SPARE' ↓ DELOCALISED ELECTRONS CREATE WEAK BONDS BETWEEN → CAN SLIDE!
ONE LAYER = GRAPHENE
ALLOTROPES OF CARBON → C_{60} (BUCKMINSTER) FULLERENE (BUCKY BALL)
NANOTUBES. ALL ABOVE USED AS LUBRICANT, DUE TO LOW FRICTION BETWEEN MOLECULES/LAYERS

METALLIC BONDING
ATOMS FORM LATTICE: IONS SURROUNDED BY FREE-MOVING, DELOCALISED ELECTRONS.
- CAN CONDUCT ELECTRICITY.

POLYMERS
CARBON BASED MOLECULES (MONOMERS) JOINED TOGETHER TO MAKE HIGH MOLECULAR MASS POLYMERS
e.g. ethene → polyethene (HIGH PRESSURE + CATALYST NEEDED FOR POLYMERISATION)

MASS IS ALWAYS CONSERVED: ATOMS ARE NOT CREATED OR DESTROYED IN CHEMICAL REACTIONS.
BALANCING EQUATIONS: CAN ONLY MULTIPLY, CANNOT CHANGE FORMULA: ← IF 1 MOLE Zn used, 2 MOLES HCl NEEDED. IF LESS THAN 2 MOLES HCl, REACTION INCOMPLETE
e.g. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ ✓
START WITH COMPLEX MOLECULES, END ON ELEMENTS (IF POSS).

RELATIVE ATOMIC/FORMULA MASS (^{12}C)
MOLES = 'GRAMS' / 'RAMS'
1 mole = 6.02×10^{23} atoms/molecules.
'RAM' $CO_2 = 12 + (2 \times 16) = 44$
*SOLUTION CONCETRATION: g/dm^3 or mol/dm^3 $1dm^3 = 1000cm^3$ or ml
So concentration = grams/ ÷ volume.

GCSE CHEMISTRY PAPER 1

HCl IS THE LIMITING REACTANT.

Q: "HOW MANY kg OF $ZnCl_2$ CAN BE MADE FROM 3kg of Zn?" (LONG WAY) ✓ MASS → MOLES → MOLES → MASS
OR
TITRATION → USED TO CALCULATE CONCENTRATIONS e.g.
e.g. 50cm³ of base (alkali) e.g. NaOH
- add methyl orange indicator.
- Do rough titre to get rough vol needed. (turns pink → neutral)
- Repeat, but near rough value slow down rate, add drop, swirl.
- If stays pink, complete.
- If stoichiometry (ratio) is 1:1 e.g. HCl + NaOH, same moles added, calc conc = mol ÷ vol used.
burette (acid) e.g. HCl
0.1 mol/dm³

*% YIELD = MASS OF PRODUCTS / MAX THEORETICAL : AS REACTIONS OFTEN DON'T COMPLETE - ESPECIALLY REVERSIBLE.

*ATOM ECONOMY = MASS OF DESIRED PRODUCTS / TOTAL MASS OF REACTANTS (CAN USE RAMS)

*MOLAR GAS: 1 MOLE OF ANY GAS = $24dm^3$.
So: VOL = 24 × MOLES

pH: 1 — 7 — 14 LOGARITHMIC acid neutral alkali SCALE i.e. 2 → 1, 10× HIGHER CONC^{n} H^+ IONS. (OH$^-$ FOR ALKALI)
STRONG ACID: ONE WHICH DISSOCIATES/IONISES EASILY/COMPLETELY e.g. $H^+ Cl^-$.

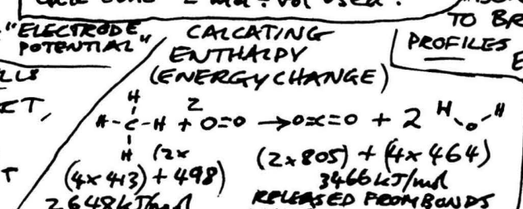
QUANTITATIVE CHEMISTRY

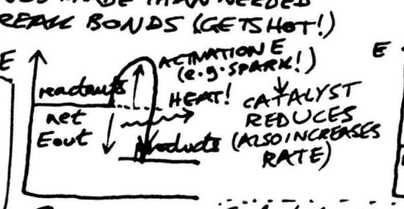
ELECTROLYSIS: USED TO SEPARATE CHEMICALS
e.g. NaCl (brine) SOLUTION
ANODE (+) CARBON ELECTRODES CATHODE (-)
Na^+ Cl^- H^+ OH^-
IONS ARE DISSOCIATED, FREE TO MOVE.
H^+ MOVE TO CATHODE (CATIONS) GAIN MISSING ELECTRON:
$2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$ IONIC EQN.
(Na^+ DOESN'T, STAYS IN SOLN AS NaOH AS MORE REACTIVE THAN H)
Cl^- MOVE TO ANODE (ANIONS), LOSE EXTRA ELECTRON
$2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$
OXIDATION IS LOSS (OF ELECTRONS)
REDUCTION IS GAIN

PURIFYING METALS WITH ELECTROLYSIS
IMPURE Cu → $Cu^{2+} + 2e^-$
PURE Cu
$CuSO_4$ electrolyte
INSOLUBLE IMPURITIES → $Cu^{2+} + 2e^- \rightarrow Cu$ (NO H_2, AS Cu LESS REACTIVE)
ATOMS OXIDISED, IONS MOVE TO CATHODE TO BE REDUCED

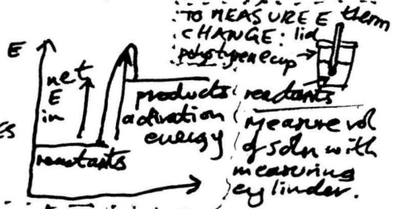
CELLS/BATTERIES: METAL IN SOLN OF OWN IONS WILL IONISE. DIFF IN CHARGE BETWEEN THEM = "ELECTRODE POTENTIAL"
e.g. Zn, Cu, $ZnSO_4$, $CuSO_4$, salt bridge
(Zn^{2+} and SO_4^{2-} MOVE TO THIS)

FUEL CELLS
$H_2 + O_2$ REACT, PRODUCING VOLTAGE. NO POLLUTION! JUST H_2O.

CALCATING ENTHALPY (ENERGY CHANGE)

(4×413) + 498 = 2648kJ/mol NEEDED TO BREAK BONDS
(2×805) + (4×464) = 3466kJ/mol RELEASED FROM BONDS MADE
SO 818 kJ/mol NET E RELEASED:

PROFILES


ENERGY REQUIRED TO BREAK COVALENT BONDS
e.g. C-H BOND: 413 kJ/mol. SAME AMOUNT 'MADE' OR RELEASED WHEN MADE.
*EXOTHERMIC: MORE ENERGY RELEASED FROM BONDS MADE THAN NEEDED TO BREAK BONDS (GETS HOT!)
*ENDOTHERMIC: MORE ENERGY NEEDED TO BREAK BONDS THAN RELEASED FROM BONDS MADE (GETS COLD!)



Calculate $E = m \times SHC \times \Delta T$
vol in cm^3 4.2 temp change.

©Science Shorts Video