BMS1011 – All Lecture Summaries: Exam Revision.

Lecture 1 – Atoms & Atomic Structure

Atomic structure

- Atoms contain **protons, neutrons and electrons**.
- Electrons occupy different **energy levels/orbitals**.
- **Valence electrons** = outer-shell electrons involved in bonding.
- **Core electrons** = inner electrons that contribute to electron shielding.

Chemical bonding

Ionic bond

- Electrostatic attraction between oppositely charged ions.
- Usually associated with a large electronegativity difference.

Covalent bond

- Atoms **share electrons**.
- Formed by overlap of atomic orbitals.

Weak/non-covalent interactions

Important in biological molecules:

- Hydrogen bonds
- Dipole–dipole interactions
- London dispersion/van der Waals forces

Individually weak, but many together can strongly stabilise biological structures.

Lewis structures & resonance

- Lewis structures show **valence electrons and bonding**.
- **Resonance** occurs when electrons can be represented in multiple equivalent arrangements.
- Actual electrons are **delocalised**, rather than rapidly switching between structures.

VSEPR

Electron groups repel one another and arrange to minimise repulsion → determines molecular geometry.

Electronegativity & polarity

Electronegativity:

- **↑ across a period**
- **↑ up a group**

Difference in electronegativity determines bond polarity. Molecular polarity also depends on the **3D geometry** of the molecule.

Lecture 2 – Chemical Equilibrium, Acids & Bases

Acids and bases

Brønsted–Lowry:

- **Acid = H^+ donor**
- **Base = H^+ acceptor**

Strong acids/bases ionise essentially completely; weak acids/bases only partially ionise.

Chemical equilibrium

At equilibrium:

- Forward rate = reverse rate.
- Concentrations remain **constant**, but are **not necessarily equal**.

Equilibrium constant

- Large K → products favoured.
- Small K → reactants favoured.

Acid-base calculations

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$$
$$pH = -\log[H^+]$$
$$pK_a = -\log K_a$$

Lower pKa → **stronger acid**.

Buffers

Buffers resist changes in pH and usually contain a:

weak acid + its conjugate base

Henderson–Hasselbalch:

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

Buffering is strongest when **pH ≈ pKa**.

Lecture 3 – Functional Groups & Organic Chemistry

Know the major functional groups:

- Alkane
- Alkene
- Alkyne
- Aromatic/benzene
- Alcohol
- Ether
- Aldehyde
- Ketone
- Carboxylic acid
- Ester
- Amine
- Amide
- Haloalkane

Carbonyl group

C=O is **polar** because oxygen is more electronegative than carbon.

Alcohol oxidation

- **Primary alcohol → aldehyde → carboxylic acid**
- **Secondary alcohol → ketone**
- **Tertiary alcohol → resistant to simple oxidation**

Physical properties

Boiling point depends strongly on intermolecular forces: