Fields of advanced difficulty

Theoretical

1. **Stereochemistry** Newman projections; models for control of addition of new stereocentres (Felkin-Anh, Zimmerman-Traxler); geometrical isomers of square planar and octahedral transition metal complexes; recognising isomer possibilities in molecules with multiple stereocentres.
2. **Enzymes** Enzyme classification according to reaction types; isotope-labelling studies; metabolic pathways involving coenzyme A.
3. **Phase and chemical equilibria** Latent heats and the Clausius-Clapeyron equation; colligative properties; temperature dependence of equilibrium constants.
4. **Analytical techniques** Mass spectrometry (molecular ions, fragmentation, isotope distribution); interpretation of IR data.
5. **Photochemistry** Photocatalysis; band gaps; quantum yields; semiconductors.
6. **MO theory** MO diagrams for diatomics; metal-ligand interactions.

The following topics will not appear at CCO 2025

- Formal group theory
- Planar, axial, or helical chirality
- Enzymatic kinetics
- Quantitative understanding of any isotope effects
- Kinetics of complex reactions
- Steady state and quasi equilibrium approximations
- NMR spectroscopy
- Synthetic polymers
- Photocatalytic organic mechanisms
- Pericyclic organic mechanisms
- Crystal field theory
- Thermodynamics and kinetics of adsorption
- Solid state crystal structures

Students are not expected to:

- Remember metabolic pathways by heart

SYLLABUS OF THE CANADIAN CHEMISTRY OLYMPIAD

Level 1: These topics are included in the overwhelming majority of secondary school chemistry programs.
Level 2: These topics are included in a substantial number of secondary school programs and maybe used without mention in the fields of advanced difficulty.
Level 3: These topics are not included in the majority of secondary school programs and can only be used in the competition if mentioned in the fields of advanced difficulty.

1. Atoms

1.1.	*Introduction*		
	1.1.1.	Counting of nucleons	1
	1.1.2.	Isotopes	1
1.2.	*The hydrogen atom*		
	1.2.1.	Concept of energy levels	1
	1.2.2.	Shape of *s*-orbitals	1
	1.2.3.	Shape and orientation of *p*-orbitals	1
	1.2.4.	Shape and orientation of *d*-orbitals	2
	1.2.5.	Understanding the simplest Schrodinger equation	3
	1.2.6.	Square of the wave function and probability	3
	1.2.7.	Quantum numbers (n, l, m_l)	2
1.3.	*Radioactivity*		
	1.3.1.	Types of radioactivity	1
	1.3.2.	Radioactive decay	1
	1.3.3.	Nuclear reactions	2

2. Chemical bonding

2.1.	*Bond types*		
	2.1.1.	Covalent, ionic, metallic and coordination	1
	2.1.2.	Intermolecular forces and relation to properties	2
	2.1.3.	Coordination	3
2.2.	*Lewis theory and VSEPR – Simple molecular structures with*		
	2.2.1.	No more than four electron pairs about central atom	1
	2.2.2.	Dipole moment of molecules (dipole/no dipole)	2
	2.2.3.	With central atom exceeding the "octet rule"	2
2.3.	Sigma and pi bonds		1
2.4.	*Delocalization, aromaticity and resonance structures*		2
2.5.	*Hybrid orbital theory*		3
2.6.	*Molecular orbital theory*		
	2.6.1.	Molecular orbital diagram (H_2 molecule)	3
	2.6.2.	Molecular orbital diagram (N_2 and O_2 molecules)	3
	2.6.3.	Bond orders in O_2, O_2^-, O_2^+	3
	2.6.4.	Unpaired electrons and paramagnetism	3

3. Chemical calculations

3.1.1.	Balancing equations	1
3.1.2.	Stoichiometric calculations	1
3.1.3.	Mass and volume relations (including density)	1
3.1.4.	Empirical formula	1
3.1.5.	Mole concept and Avogadro's number	1
3.1.6.	Concentration calculations (with different units)	1

4. Periodic trends

4.1.	*Electron Configuration*		
	4.1.1.	Pauli exclusion principle	1
	4.1.2.	Hund's Rule	1
	4.1.3.	Main group elements	1
	4.1.4.	First-row transition metal atoms and their ions	1
	4.1.5.	Transition metal atoms and their ions, beyond first row	3
	4.1.6.	Lanthanide and actinide metals	3
4.2.	*Electronegativity*		1
4.3.	*Electron affinity*		2
4.4.	*First ionization energy*		1
4.5.	*Atomic size*		1
4.6.	*Ionic size*		1
4.7.	*Highest oxidation number*		1
4.8.	*Reactivity*		1

5. Inorganic Chemistry

5.1.	*Trends in physical properties of elements (Main groups)*		
	5.1.1.	Melting point	1
	5.1.2.	Boiling point	1
	5.1.3.	Metallic character	1
	5.1.4.	Magnetic properties	3
	5.1.5.	Electrical conductivity	2
5.2.	*Oxidation number*		1
5.3.	*Nomenclature*		
	5.3.1.	Main group compounds	1
	5.3.2.	Transition metal compounds	1
	5.3.3.	Simple metal complexes	3
5.4.	*Groups 1 and 2*		
	5.4.1.	Trend in reactivity of (heavy elements more reactive)	1
	5.4.2.	Product of reaction with water	1
	5.4.3.	Product of reaction with halogens	1
	5.4.4.	Product of reaction with oxygen	1
	5.4.5.	Basicity of oxides	1
	5.4.6.	Properties of hydrides	3
	5.4.7.	Other compounds, properties and oxidation states	3
5.5.	*Groups 13 – 18 and Hydrogen*		
	5.5.1.	Binary molecular compounds of hydrogen, reactions and properties	1
	5.5.2.	Acid-base properties of CH_4, NH_3, H_2O, H_2S	1
	5.5.3.	Other properties of binary molecular compounds of hydrogen	3
	5.5.4.	The oxidation state of boron in oxides and chlorides is +3	1
	5.5.5.	The oxidation state of aluminium in oxides and chlorides is +3	1
	5.5.6.	The acid-base properties of aluminium oxide/hydroxide	2
	5.5.7.	Reaction of boron(III) oxide with water	3
	5.5.8.	Reaction of boron(III) chloride with water	3
	5.5.9.	Other compounds, properties and oxidation states	3
5.6.	*Group 14*		
	5.6.1.	The oxidation state of Si in its chloride and oxide is +4	1
	5.6.2.	The +2 and +4 oxidation states of carbon, tin and lead	2
	5.6.3.	Acid-base properties of the oxides of C, Sn, Pb +2 and +4	2
	5.6.4.	Acid-base properties of the chlorides of C, Sn, Pb +2 and +4	2

5.6.5.	Redox properties of the oxides and chlorides of C, Sn, Pb +2 and +4	2
5.6.6.	Other compounds, properties and oxidation states	3
5.6.7.	Semiconductors	3
5.7.	*Group 15*	
5.7.1.	Phosphorus(+5) oxide and chloride, and their reaction with water	2
5.7.2.	Phosphorus(+3) oxide and chloride, and their reaction with water	2
5.7.3.	Reaction of NO to form NO_2	1
5.7.4.	Dimerization of NO_2	1
5.7.5.	Reaction of NO_2 with water	1
5.7.6.	Redox properties of HNO_3 and nitrates	1
5.7.7.	Redox properties of HNO_2 and NH_2NH_2	3
5.7.8.	Bi(+5) and Bi(+3)	3
5.7.9.	Other compounds, properties and oxidation states	3
5.8.	*Group 16*	
5.8.1.	S(+4) and S(+6) reaction of their oxides with water	1
5.8.2.	S(+4) and S(+6) properties of their acids	1
5.8.3.	Reaction of thiosulfate anion with I_2 (iodometry)	3
5.8.4.	Other compounds, properties and oxidation states	3
5.9.	*Group 17 – Halogens*	
5.9.1.	Reactivity and oxidant strength decrease from F_2 to I_2	1
5.9.2.	Acid-base properties of the hydrogen halides	1
5.9.3.	The oxidation state of fluorine in its compounds is –1	1
5.9.4.	The –1, +1, +3, +5, +7 oxidation states of chlorine	1
5.9.5.	Mononuclear oxoanions of chlorine	2
5.9.6.	Reactions of halogens with water	2
5.9.7.	Reaction of Cl_2O and Cl_2O_7 with water	3
5.9.8.	Other compounds, properties and oxidation states	3
5.10.	*Group 18*	3
5.11.	*Transition elements*	
5.11.1.	Common oxidation states of common transition metals: Cr(+3), Cr(+6) Mn(+2), Mn(+4), Mn(+7) Ag(+1) Fe(+2), Fe(+3) Co(+2), Zn(+2), Hg(+1), Hg(+2) Cu(+1), Cu(+2) Ni(+2)	1
5.11.2.	Colours of ions listed above in aqueous solution	2
5.11.3.	Insolubility of Ag, Hg and Cu in HCl	2
5.11.4.	M^{2+} arising by dissolution of the other metals in HCl	2
5.11.5.	$Al(OH)_3$, $Cr(OH)_3$ and $Zn(OH)_2$ are amphoteric	2
5.11.6.	Other +2 oxides/hydroxides of the metals listed above are basic	2
5.11.7.	MnO_4^- and $Cr_2O_7^{2-}$ are strong oxidants in acid solution	1
5.11.8.	pH dependence of products of MnO_4^- acting as oxidant	2
5.11.9.	Interconversion between CrO_4^{2-} and $Cr_2O_7^{2-}$	3
5.11.10.	Other compounds, properties and oxidation states	3
5.12.	*Lanthanides and actinides*	3
5.13.	*Coordination chemistry including stereochemistry*	
5.13.1.	Definition of coordination number	1
5.13.2.	Writing equations for complexation reactions given all formulae	1
5.13.3.	Formulae of common complex ion $Ag(NH_3)_2^+$	1
5.13.4.	Formulae of common complex ion $Ag(S_2O_3)_2^{3-}$	3
5.13.5.	Formulae of common complex ion $FeSCN^{2+}$	3
5.13.6.	Formulae of common complex ion $Cu(NH_3)_4^{2+}$	1
5.13.7.	Formulae of other complex ions	3
5.13.8.	Ligand field theory (eg and t2g terms, high and low spin)	3
5.13.9.	Cis and trans stereochemistry	3

5.13.10.	Enantiomers	3
5.14.	*Selected industrial processes*	
5.14.1.	Preparation of H_2SO_4	1
5.14.2.	Preparation of NH_3	1
5.14.3.	Preparation of Na_2CO_3	2
5.14.4.	Preparation of Cl_2 and NaOH	2
5.14.5.	Preparation of HNO_3	2

6. Physical chemistry

6.1.	*Gases*	
6.1.1.	Ideal gas law	1
6.1.2.	van der Waal's gas law	3
6.1.3.	Definition of partial pressure	2
6.1.4.	Dalton's Law	3
6.2.	*First Law of Thermodynamics*	
6.2.1.	Concept of system and surroundings	2
6.2.2.	Energy, heat and work	2
6.3.	*Enthalpy (First Law of Thermodynamics)*	
6.3.1.	Relationship between internal energy and enthalpy	2
6.3.2.	Definition of heat capacity	2
6.3.3.	Difference between C_p and C_v (ideal gas only)	3
6.3.4.	Enthalpy is a state property (Hess's Law)	2
6.3.5.	Born-Haber cycle for ionic compounds	2
6.3.6.	Use of standard formation enthalpies	2
6.3.7.	Enthalpies of solution and solvation	2
6.3.8.	Bond enthalpies (definition and use)	2
6.4.	*Second Law of Thermodynamics (Entropy and Free Energy)*	
6.4.1.	Entropy definition (dq / T)	2
6.4.2.	Entropy and disorder	2
6.4.3.	Entropy definition ($S = k \ln W$)	3
6.4.4.	Gibbs energy definition ($\Delta G = \Delta H - T\Delta S$)	2
6.4.5.	Using ΔG to predict direction of natural (spontaneous) change	2
6.4.6.	Relationship between $\Delta G°$ and equilibrium constant K	2
6.4.7.	Temperature dependence of equilibrium constants	3
6.5.	*Chemical Equilibrium*	
6.5.1.	Le Chatelier's principle	1
6.5.2.	K_{eq} in terms of concentrations, pressures and mole fractions	1
6.5.3.	Arrhenius definitions of acids and bases	1
6.5.4.	Bronsted-Lowry definitions	1
6.5.5.	Conjugate acids and bases	1
6.5.6.	pH definition	1
6.5.7.	K_w definition	1
6.5.8.	K_a and K_b as a measure of acid and base strength	1
6.5.9.	Acidity or basicity of ions	1
6.5.10.	Calculation of pH from pK_a(weak acid)	1
6.5.11.	Calculation of pH of a simple buffer solution	2
6.6.	*Gas phase equilibrium*	
6.6.1.	Equilibrium constant in partial pressures	3
6.6.2.	Relating K_p and K_c	3
6.7.	*Solubility (equilibrium)*	
6.7.1.	Solubility constant (product) definition (K_{SP})	2

6.7.2.	Calculation of solubility in water from K_{SP}	2
6.8.	*Complexometric equilibrium*	
6.8.1.	Complex formation constant (definition)	2
6.8.2.	Problems involving complexometric equilibria	3
6.8.3.	Lewis acids and bases	3
6.8.4.	Hard and soft Lewis acids and bases	3
6.9.	*Phase equilibrium*	
6.9.1.	Temperature dependence of vapor pressure	3
6.9.2.	Clausius-Clapeyron equation	3
6.9.3.	Single component phase diagrams, triple point	3
6.9.4.	Single component phase diagrams, critical point	3
6.9.5.	Ideal and nonideal liquid-vapor systems	3
6.9.6.	Liquid-vapor phase diagrams	3
6.9.7.	Use of liquid-vapor phase diagrams in fractional distillation	3
6.9.8.	Henry's Law	3
6.9.9.	Raoult's Law	3
6.9.10.	Deviation from Raoult's Law	3
6.9.11.	Boiling point elevation	3
6.9.12.	Freezing point depression	3
6.9.13.	Osmotic pressure	3
6.9.14.	Partition coefficient, definition and simple calculations	2
6.9.15.	Solvent extraction	3
6.10.	*Multiple equilibrium reactions*	
6.10.1.	Calculation of pH for multiprotic acids	3
6.10.2.	Calculation of pH for weak acid mixtures	3
6.11.	*Electrochemistry*	
6.11.1.	Electromotive force (definition)	1
6.11.2.	First kind electrodes	1
6.11.3.	Standard electrode potential	1
6.11.4.	Nernst equation	2
6.11.5.	Electrolysis	2
6.11.6.	Faraday's laws	2
6.11.7.	Second kind electrodes	3
6.11.8.	Relationship between ΔG and electromotive force	3

7. Chemical kinetics

7.1.	*Factors affecting reaction rate*	1
7.2.	*Reaction coordinates and the basic idea of a transition state*	1
7.3.	*Rate law*	
7.3.1.	Rate of chemical reactions	1
7.3.2.	Elementary reactions	2
7.3.3.	Rate law for homogeneous and heterogeneous reactions	2
7.3.4.	Differential rate law	2
7.3.5.	Concept of reaction order	2
7.3.6.	Rate constant definition	2
7.4.	*Zeroth-order reactions*	2
7.5.	*First-order reactions*	
7.4.1.	Dependence of concentration on time	2
7.4.2.	Concept of half-life, exponential decay	2
7.4.3.	Relationship between half-life and rate constant	2
7.4.4.	Calculation of first order rate constant from a differential rate law	3

7.4.5.	Calculation of first order rate constant from an integrated rate law	3
7.6.	*Rate constant for second and third order reactions*	3
7.7.	*Reaction mechanisms*	
7.6.1.	Catalysis	2
7.6.2.	Concept of molecularity	2
7.6.3.	Rate-determining step	3
7.6.4.	Basic concepts of collision theory	3
7.6.5.	Reversible (opposing) parallel and consecutive reactions	3
7.8.	*Arrhenius's law*	
7.7.1.	Arrhenius equation (temperature dependance of rate constants)	2
7.7.2.	Definition of activation energy	2
7.7.3.	Calculation of activation energy	2

8. Spectroscopy

8.1.	*UV/visible*	
8.1.1.	Basic concepts of light and color	1
8.1.2.	Wavelength, frequency, wave numbers, photon energies	2
8.1.3.	Identification of aromatic compound	3
8.1.4.	Identification of chromophore	3
8.1.5.	Dyes: colour *vs* structure	3
8.1.6.	Beer's Law	2
8.1.7.	Quantum yield	3
8.2.	*Infrared*	
8.2.1.	Interpretation using a table of frequencies	3
8.2.2.	Recognition of hydrogen bonds	3
8.3.	*x-Ray*	
8.3.1.	Bragg's Law	3
8.3.2.	Concept of coordination number	2
8.3.3.	Concept of unit cell	3
8.3.4.	Solid structure of NaCl	3
8.3.5.	Solid structure of CsCl	3
8.3.6.	Solid structure of metals	3
8.4.	*NMR*	
8.4.1.	Chemical shift concept	3
8.4.2.	Spin-spin coupling and coupling constants	3
8.4.3.	Integration	3
8.4.4.	Interpretation of a simple 1H spectrum (like ethanol)	3
8.4.5.	Identification of *o*- and *p*-disubstituted benzene	3
8.4.6.	Interpretation of simple spectra of ^{13}C (proton decoupled)	3
8.4.7.	Other 1/2 spin nuclei	3
8.5.	*Mass spectrometry*	
8.5.1.	Recognition of molecular ion	3
8.5.2.	Recognition of fragments with the help of a table	3
8.5.3.	Recognition of typical isotope distribution	3

9. Organic Chemistry

9.1.	*Alkane naming (IUPAC)*	1
9.2.	*Trends in boiling points*	
9.2.1.	Alkanes with structure	1
9.2.2.	Alcohols *vs* ethers due to hydrogen-bonding	1
9.3.	*General organic reactions concepts*	
9.3.1.	Polarity (polar *vs* non-polar molecules/solvents)	*2*
9.3.2.	Common electrophiles and nucleophiles	2
9.3.3.	Use of common protecting groups in organic synthesis	2
9.3.4.	Simple multistep organic synthesis	2
9.3.5.	Models for control of addition of new stereocenters	3
9.4.	*Geometry at singly, doubly, and triply bonded carbon and other centers*	1
9.5.	*Identification of common functional groups*	1
9.6.	*Isomerism and stereochemistry*	
9.6.1.	Isomerism (constitutional, configuration and conformation)	1
9.6.2.	Cis-trans isomerism of alkenes	1
9.6.3.	E/Z classification of alkenes	2
9.6.4.	Optical activity of Enantiomers	2
9.6.5.	R/S nomenclature (Cahn-Ingold-Prelog or CIP system)	2
9.7.	*Alkanes*	
9.7.1.	Reaction with halogens products	1
9.7.2.	Reaction with halogens radical mechanism (initiation, termination)	2
9.7.3.	Naming cycloalkanes	2
9.7.4.	Strain in small rings	3
9.7.5.	Chair/boat conformations of cyclohexane	2
9.8.	*Alkenes*	
9.8.1.	Products from Br_2, HBr and H_2O/H^+	1
9.8.2.	Mechanism involving carbocation intermediates	2
9.8.3.	Relative stability of carbocations	2
9.8.4.	Electrophilic addition to double bonds	2
9.8.5.	Markownikoff/Kharash rule	2
9.8.6.	Nucleophilic addition to double bonds	2
9.8.7.	Nucleophilic addition acid-base catalysis	2
9.8.8.	1,4-addition to dienes	3
9.9.	*Alkynes*	
9.9.1.	Acidity relative to alkenes	3
9.9.2.	Electrophilic addition to triple bonds	2
9.9.3.	Regioselectivity of electrophilic additions	2
9.9.4.	Nucleophilic addition to triple bonds	2
9.9.5.	Differences in chemical properties from alkenes	2
9.10.	*Benzene, electrophilic substitution (nitration, halogenation)*	
9.10.1.	Formula and structure	1
9.10.2.	Stabilization by resonance	1
9.10.3.	Directing effect of first substituent	3
9.10.4.	Influence of substituents on reactivity and regioselectivity	3
9.10.5.	Explanation of substituent effects	3
9.11.	*Halogen compounds*	
9.11.1.	Nomenclature of monofunctional	1
9.11.2.	Electrophilicity and nucleophilicity	2
9.11.3.	Substitution reactions giving alcohols	3
9.11.4.	Substitution reactions in which halogen is exchanged	3

9.11.5.	Substitution reactivity of primary *vs* secondary *vs* tertiary	3
9.11.6.	Substitution reactivity of aliphatic *vs* aromatic	3
9.11.7.	S_N1 and S_N2 mechanisms	3
9.11.8.	E1 and E2 elimination reactions	2
9.11.9.	Acid-base catalysis for elimination reactions	2
9.11.10.	Competition of elimination and substitution	2
9.12.	*Alcohols*	
9.12.1.	Nomenclature of monofunctional	1
9.12.2.	Comparison of acidity of alcohols and phenols	2
9.12.3.	Dehydration to alkenes	1
9.12.4.	Forming esters with inorganic acid	2
9.12.5.	Oxidation reactions	1
9.13.	*Aldehydes and ketones*	
9.13.1.	Nomenclature of monofunctional	1
9.13.2.	Oxidation of aldehydes	1
9.13.3.	Reduction to alcohols (LiAlH4, NaBH4)	3
9.13.4.	Keto/enol tautomerism	2
9.13.5.	Nucleophilic addition reactions with HCN	3
9.13.6.	Nucleophilic addition reactions with RNH_2 (R = alkyl, HO, NH_2)	3
9.13.7.	Nucleophilic addition with enolate anions (aldol condensation)	3
9.13.8.	Nucleophilic addition with alcohols to form acetals/ketals	3
9.13.9.	Nucleophilic addition with Grignard reagents	3
9.14.	*Carboxylic acids and their derivatives*	
9.14.1.	Nomenclature of carboxylic acids, esters, acid halides and amides	2
9.14.2.	Acidity strength related to inductive effects	3
9.14.3.	Preparation of carboxylic acids by hydrolysis of esters (soaps)	1
9.14.4.	Preparation of carboxylic acids by hydrolysis of amides	2
9.14.5.	Preparation of carboxylic acids by hydrolysis of nitriles	3
9.14.6.	Reaction of carboxylic acids with alcohols to form esters	1
9.14.7.	Reaction of carboxylic acids to form acid chlorides	3
9.14.8.	Reaction of carboxylic acids to form anhydrides	3
9.14.9.	Reaction of acid chlorides to form amides	3
9.14.10.	Mechanism of esterification	3
9.14.11.	Multifunctional acids (hydroxyacids, ketoacids)	3
9.14.12.	Polycarboxylic acids	3
9.15.	*Amines*	
9.15.1.	Nomenclature of simple amines	1
9.15.2.	Recognition of primary, secondary and tertiary amines	1
9.15.3.	Basicity as a property of an amine	1
9.15.4.	Comparison of basicity of aliphatic and aromatic amines	3
9.15.5.	Comparison of basicity of amines and amides	3
9.15.6.	Preparation of amines from halides	3
9.15.7.	Preparation of amines from aromatic nitro compounds	3
9.15.8.	Preparation of amines from amides (by hydrolysis)	3
9.15.9.	Diazotization of aliphatic amines	3
9.15.10.	Diazotization of aromatic amines	3
9.16.	*Nitriles*	
9.16.1.	Nomenclature of simple nitriles	2
9.16.2.	Nucleophilic additions	2
9.16.3.	Hydrolysis of nitriles to form carboxylic acids	2
9.16.4.	Acid-base catalysis of nitriles hydrolysis	3

10. Polymers

10.1.	*Synthetic addition polymers (polyaddition)*	
10.1.1.	Polystyrene	2
10.1.2.	Polyethene	1
10.1.3.	Chain mechanism of formation	2
10.2.	*Synthetic condensation polymers (polycondensation)*	
10.2.1.	Polyesters	2
10.2.2.	Polyamides	2
10.3.	*Chain polymerizations*	2
10.4.	*Silicones*	3
10.5.	*Concept of cross-linking and its effect on properties*	3
10.6.	*Natural polymers*	
10.6.1.	Silicates	3
10.6.2.	Rubber	3

11. Biochemistry

11.1.	*Carbohydrates*	
11.1.1.	Structure of glucose and fructose	
11.1.2.	Open chain	1
11.1.3.	Cyclic form	2
11.1.4.	Fischer projections	2
11.1.5.	Haworth formulae	3
11.1.6.	Difference between starch and cellulose	2
11.1.7.	Difference between α- and β- D glucose	2
11.2.	*Lipids*	
11.2.1.	Structure of lipids in relationship to properties	2
11.2.2.	Formula of glycerol	1
11.2.3.	General formulae of di- and triacyl glycerides	1
11.2.4.	Saturated and unsaturated fatty acids	2
11.2.5.	Hydrophilic and hydrophobic groups	1
11.2.6.	micelle and bilayer formation	2
11.3.	*Amino acids*	
11.3.1.	Ionic structure	1
11.3.2.	Isoelectric point	3
11.3.3.	L and D amino acids are enantiomers	2
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