Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		

I. Mixtures determine everyday life (~10 double periods)

1. Introduction to Chemistry - Working as a Chemist

Name the significance of *hazard pictograms* and derive safe handling of hazardous substances therefrom. P 2.1 Knowledge acquisition 6 P 2.3 Evaluation 11	Name the significance of *hazard pictograms* and derive safe handling of hazardous substances therefrom. P 2.1 Knowledge acquisition 6 P 2.3 Evaluation 11	Name the significance of *hazard pictograms* and derive safe handling of hazardous substances therefrom. P 2.1 Knowledge acquisition 6 P 2.3 Evaluation 11	Games (TA) • Assign pictograms • Laboratory-equipment memory	I. Safety instructions (K,J,P,W) II. Information on proper disposal (K,J,P,W)
Plan, carry out and explain fire safety measures P 2.1 Knowledge acquisition 3, 4 9 P 2.2 Communication 4, 6, 10 P 2.3 Evaluation 1, 7, 8, 11 L PG, BO	Plan, carry out and explain fire safety measures P 2.1 Knowledge acquisition 3, 4,9 P 2.2 Communication 4, 6, 10 P 2.3 Evaluation 1, 7, 8, 11 L PG, BO	Plan, carry out and explain fire safety measures P 2.1 Knowledge acquisition 3 4,9 P 2.2 Communication 4, 6, 10 P 2.3 Evaluation 1, 7, 8, 11 L PG, BO	Handling of a fire extinguisher “Burner certificate”	Safe handling of the Bunsen burner (K,J,P,W)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
$G_{(Basic\ level)}$	$M_{(Intermediate\ level)}$	$E_{(Advanced\ level)}$		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
2. Properties of Substances, pure substances, mixture of substances and separation processes				
Experimentally examine and describe properties of substances (*colour, smell, deformability, density, magnetisability, electrical conductivity, melting temperature, boiling temperature, solubility in water*(*qualitative*)	Experimentally examine and describe properties of substances (*colour, smell, deformability, density, magnetisability, electrical conductivity, melting temperature, boiling temperature, solubility* (*qualitative*)	Experimentally examine and describe properties of substances (*colour, smell, deformability, density, magnetisability, electrical conductivity, melting temperature, boiling temperature, solubility*	Introduction: Procedure: Learner experiment: Determine different flame temperatures by means of magnesia rods Learner experiment: Determine the density of a spatula Learner experiment: Experiments on solubility and conductivity	Experiment: Extraction of gold (J) Experiment: Salt extraction from sea water (K, W)
P Knowledge acquisition 1,7,8 P 2.2 Communication 10	P Knowledge acquisition 1,7,8 P 2.2 Communication 10	P Knowledge acquisition 1,7,8 P 2.2 Communication 10		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
Name combinations of characteristic properties of selected substances (*Oxygen, carbon dioxide, water, hydrogen, iron, copper, sodium chloride*)	Name combinations of characteristic properties of selected substances (*Oxygen, carbon dioxide, water, hydrogen, iron, copper, magnesium, sodium chloride*)	Name combinations of characteristic properties of selected substances (*Air, Oxygen, carbon dioxide, water, hydrogen, chlorine, iron, copper, silver, magnesium, sodium chloride, magnesium oxide*)	Design a poster: Create a profile	Experiment: "What is the unknown substance?" (K,J,P,W)
P 2.1 Knowledge acquisition 4 P 2.2 Communication 2	P 2.1 Knowledge acquisition 4 P 2.2 Communication 2	P 2.1 Knowledge acquisition 4 P 2.2 Communication 2		
Plan and conduct an experiment on separation of a mixture of substances	Plan and conduct an experiment on separation of a mixture of substances	Plan and conduct an experiment on separation of a mixture of substances	Learner experiment: Sieving, filtration, evaporation, distillation, oil separation, chromatography	Simplified distillation apparatuses (K,J, P, W) Extraction lavender blossoms (K)
P 2.1 Knowledge acquisition 5 6,7 P 2.2 Communication 10 P 2.3 Evaluation 3	P 2.1 Knowledge acquisition 5,6,7 P 2.2 Communication 10 P 2.3 Evaluation 3	P 2.1 Knowledge acquisition 5 6,7 P 2.2 Communication 10 P 2.3 Evaluation 3		
Present and apply a useful model to classify substances (*element, compound, metal, non-metal, pure substance,*	Present and apply a useful model to classify substances (*element, compound, metal, non-*	Present and apply a useful model to classify substances (*element, compound, metal, non-metal, pure substance,*	Working with mind maps	Hand out DSK booklet Basic knowledge on Chemistry (K)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
mixture of substances, solution, gas mixture, alloy, suspension, emulsion, smoke, fog)	*metal, pure substance, mixture of substances, mixture, solution, gas mixture, alloy, suspension, emulsion, smoke, fog*)	*homogeneous and heterogeneous mixture of substances, mixture, solution, gas mixture, alloy, suspension, emulsion, smoke, fog*)		
P 2.1 Knowledge acquisition 8 9 P 2.2 Communication 3 P 2.3 Evaluation 2	P 2.1 Knowledge acquisition 8 9 P 2.2 Communication 3 P 2.3 Evaluation 2	P 2.1 Knowledge acquisition 8 9 P 2.2 Communication 3 P 2.3 Evaluation 2		
3. The ball particle model				
Describe *aggregate states* and *solution-finding procedures* by means of a suitable *particle model*(*substance particles)*	Describe *aggregate states*, *solution-finding procedure* and *diffusion* by means of a suitable *particle model*(*substance particles)*	Describe *aggregate states*, *solution-finding procedures* and *diffusion* and the *BROWNIAN motion* by means of a suitable *particle model*(*substance particles)*	• Learner experiment: Alcohol + water • Work with models • Model experiment: Peas + mustard seeds • Learner experiment: Tea bags or potassium permanganate in water • Berlin Blue experiment (petri dish): Experiment 05 SE Chemistry - but safely • Demo-experiment: Deodorant • Syringe experiments with air	Beach chemistry: Excursion to Camps Bay beach (K)
P 2.1 Knowledge acquisition 11 P 2.2 Communication 4, 6 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 11 P 2.2 Communication 4, 6 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 11 P 2.2 Communication 4, 6 P 2.3 Evaluation 1		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
			(pressure)	
Explain solid state of the aggregate by means of attracting forces between substance particles P 2.1 Knowledge acquisition 10 P 2.2 Communication 4, 5, 6, 9 P 2.3 Evaluation 2,7	Explain physical states of the aggregate by means of interactions between substance particles and their movement P 2.1 Knowledge acquisition 10 P 2.2 Communication 4, 5, 6 9 P 2.3 Evaluation 2,7	Explain physical states of the aggregate by means of interactions between substance particles and their movement P 2.1 Knowledge acquisition 10,11 P 2.2 Communication 4, 5, 6, 9 P 2.3 Evaluation 2,7	• Home experiment: Heating of methylated spirits inside a balloon • Learner experiment: Heating of iodine	

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
$G_{(Basic\ level)}$	$M_{(Intermediate\ level)}$	$E_{(Advanced\ level)}$		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
4. Material and Energy characteristics of a chemical reaction 5. Chemical elements and chemical compounds				
Name observable characteristics of chemical reactions P 2.1 Knowledge acquisition 1	Describe observable characteristics of chemical reactions P 2.1 Knowledge acquisition 1	Describe observable characteristics of chemical reactions P 2.1 Knowledge acquisition 1	• Experiment: Heating of sugar and magnesium • Water electrolysis (learner exercise: 06_RE_Chemistry- but safely) • Experiment: Reaction of sulphur and iron • Reaction of zinc and copper chloride (06_RE_Chemistry-but safely) • Can-experiment (blast-gas explosion) • Experiment: Heating of iron wool & • animation (www.chemie-interaktiv.net) • SV: Loss in mass - burning candle • SV: Experimental determination of the mass ratio between copper and sulphur during copper-	Complete DSK booklet Basic knowledge on Chemistry (K)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
			sulphide-synthesis	
Explain energy phenomena in chemical reactions by converting some of the energy stored in substances into other forms of energy (*light, heat, sound*)	Explain energy phenomena in chemical reactions by converting some of the energy stored in substances into other forms of energy (*light, heat, sound*)	Explain energy phenomena in chemical reactions by converting some of the energy stored in substances into other forms of energy (*light, heat, sound*)	• SV: Ammonium nitrate + water • Evaluation of diagrams • Show Experiment: Chemical lamps • Teacher experiment: Can explosions	
P 2.1 Knowledge acquisition 1 2 P 2.2 Communication 4, 5, 6, 8 P 2.3 Evaluation 2,7 F Physics Energy	P 2.1 Knowledge acquisition 1,2 P 2.2 Communication 4, 5, 6, 8 P 2.3 Evaluation 2,7 F Physics Energy	P 2.1 Knowledge acquisition 1.2 P 2.2 Communication 4, 5, 6, 8 P 2.3 Evaluation 2,7 F Physics Energy		
Assign the terms *exothermic and endothermic* to the corresponding phenomena	Assign the terms *exothermic and endothermic* to the corresponding phenomena	Explain and assign the terms *exothermic and endothermic* to the corresponding phenomena	• Experiment: Heating of copper sulphate and subsequent addition of water • Experiment: Ammonium nitrate and barium hydroxide • Effervescent tablets (fizzy tablets) experiment (Chemistry-but safely)	
P 2.1 Knowledge acquisition 1 P 2.2 Communication 4	P 2.1 Knowledge acquisition 1 P 2.2 Communication 4	P 2.1 Knowledge acquisition 1 P 2.2 Communication 4		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	Compare energy conditions of reactants and products of *exothermic* and *endothermic* reactions	Compare energy conditions of reactants and products of exothermic and *endothermic* reactions		Complete DSK booklet Basic knowledge on Chemistry (K)
	P 2.1 Knowledge acquisition 2 3 P 2.2 Communication 3, 4, 5 6 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 1.2 3.8 P 2.2 Communication 3, 4, 5, 6 P 2.3 Evaluation 1		
Mention addition of heat as a requirement to start chemical reactions	Describe addition of heat as a requirement to start chemical reactions (*activation energy*)	Explain addition of heat as a requirement to start chemical reactions (*activation energy*) and compare to addition of energy in endothermic reactions.	• Repeat experiment: ○ Heating of iron and sulphur ○ Ignition of magnesium • Show Experiment: Jelly-baby inferno • Learner Experiment: Potassium permanganate in hydrogen peroxide • Show Experiment: Elephants' toothpaste	
P 2.1 Knowledge acquisition 1, 2,3 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 1, 2,3,5 P 2.2 Communication 3.4 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 1, 2,3,5,10 P 2.2 Communication 3, 4 P 2.3 Evaluation 1		
Describe the effect of *catalysts* on the course of	Describe the effects of *catalysts* on the activation	Describe the effects of *catalysts* on the activation		

Topics				
Contents				
Competencies *Learners can* $G_{(Basic\ level)}$	$M_{(Intermediate\ level)}$	$E_{(Advanced\ level)}$	**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
chemical reactions	energy	energy		
P 2.1 Knowledge acquisition 1 P 2.2 Communication 8 P 2.3 Evaluation 1, 6, 8	P 2.1 Knowledge acquisition 1 P 2.2 Communication 3, 4, 8 P 2.3 Evaluation 1, 6, 8	P 2.1 Knowledge acquisition 1 P 2.2 Communication 3, 4, 8 P 2.3 Evaluation 1, 6, 8		
Describe molecules as interconnected atoms	Describe molecules as interconnected atoms	Describe molecules as interconnected atoms	• Learner Experiment: Heating of iron and sulphur • Learner Experiment: Electrolysis of water (Chemistry - but safely) • Learner Experiment: Decomposition of hydrogen peroxide	Complete DSK booklet Basic knowledge on Chemistry (K)
P 2.1 Knowledge acquisition 10 11 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10 11 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10 11 P 2.2 Communication 4		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
II. Air (~5 double periods)				
1. Air as a mixture 2. Formation of carbon dioxide from the combustion of carbon 3. Properties of carbon dioxide and methods for detection 4. Properties of oxygen and nitrogen and methods of detection				
List the composition of air and evaluate the varying carbon dioxide portion with regard to its global impact (volume proportions of *nitrogen*, *oxygen, noble gases and carbon dioxide*). P 2.1 Knowledge acquisition 2 P 2.2 Communication 1, 2, 3, 4 P 2.3 Evaluation 1, 2, 6, 9.10 F Biology: Breathing, Photosynthesis L BNE	List the composition of air and evaluate the varying carbon dioxide portion with regard to its global impact (volume proportions of *nitrogen*, *oxygen, noble gases and carbon dioxide*). P 2.1 Knowledge acquisition 2 P 2.2 Communication 1, 2, 3 4 P 2.3 Evaluation 1, 2, 6, 9.10 F Biology: Breathing, Photosynthesis L BNE	List the composition of air and evaluate the varying carbon dioxide portion with regard to its global impact (volume proportions of *nitrogen*, *oxygen, noble gases and carbon dioxide*). P 2.1 Knowledge acquisition 2 P 2.2 Communication 1, 2, 3, 4 P 2.3 Evaluation 1, 2, 6, 9.10 F Biology: Breathing, Photosynthesis L BNE	• Experiment: Composition of air (determine volume proportions by means of syringes) • Experiment: Production of oxygen (potassium permanganate or hydrogen peroxide/ Braunstein) • Experiment: Production of hydrogen (calcium + water/zinc + hydrochloric acid) • Experiment: Production of carbon dioxide (calcium carbonate + acid) • Experiment: Matchstick experiment • Experiment: Ignition in phases and extinguishing methods	Somerset microchemistry sets (J) Learning excursion: Fire Brigade (CT, J, P, W)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
G(Basic level)	M(Intermediate level)	E(Advanced level)		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
			• Film: Quarks & Co	
Carry out and describe detection methods of selected substances (*oxygen, carbon dioxide, hydrogen, water*) P 2.1 Knowledge acquisition 1, 2,5,6,7	Carry out and describe detection methods of selected substances (*oxygen, carbon dioxide, hydrogen, water*) P 2.1 Knowledge acquisition 1,2,5,6,7	Carry out and describe detection methods of selected substances (*oxygen, carbon dioxide, hydrogen, water*) P 2.1 Knowledge acquisition 1, 2,5,6,7	• Detection experiments: Oxygen, hydrogen, carbon dioxide	
III. Metals and their significance for civilization and environment(~ 10 double periods)				
1. Occurrence, properties and application of metals 2. Reactions of metals with oxygen (transition of a non-metal oxide to the elements by supplying energy)				
describe the chemical reaction as a rearrangement	describe the chemical reaction as a rearrangement or more		Film: Quarks & Co	Excursion: Melville Koppies (J)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
of particles	specifically, as a transformation of particles (*atoms, molecules, ions*)			Visit to a gold mine (J)
P 2.1 Knowledge acquisition 10 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10 11 P 2.2 Communication 4, 5			
describe the *effects of surface area changes* as an option to control combustion processes	describe the *effects ofsurface area changes* as an option to control combustion processes	describe the *effects of surface area changes* as an option to control combustion processes	Teacher experiment: Dust- explosion with Lycopodium powder	
P 2.1 Knowledge acquisition 1 3 P 2.2 Communication 4, 6 P 2.3 Evaluation 1, 2, 7, 11	P 2.1 Knowledge acquisition 1 3 P 2.2 Communication 4, 6 P 2.3 Evaluation 1, 2, 7, 11	P 2.1 Knowledge acquisition 1 3,11 P 2.2 Communication 4.6 P 2.3 Evaluation 1, 2, 7, 11		

3. Energy-related aspects of chemical reactions
4. The reaction of metals with oxygen as an exothermic reaction
5. metal series, noble- and base metals
6. Transfer of a metal oxide into elements by supplying energy as an endothermic reaction
7. Activation energy
8. Definition of endothermic and exothermic reactions

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
describe the reversibility of chemical reactions as an example (*oxidation as oxygen absorption, reduction as oxygen emission*)	give a detailed description of the reversibility of chemical reactions as an example (*synthesis and analysis)*	give a detailed description of the reversibility of chemical reactions as an example (*synthesis and analysis)*	• How to make Ötzi's copper axe (cooperative learning) • Project: Fact sheet on metals • Experiment: Heating of iron wool compared to lighting a match	
P 2.1 Knowledge acquisition 1 6 P 2.2 Communication 4	P 2.1 Knowledge acquisition 1 6 P 2.2 Communication 4	P 2.1 Knowledge acquisition 1 6 P 2.2 Communication 4, 8		
application of the *donor-acceptor-principle* to chemical reactions with oxygen	application of the *donor-acceptor principle* to *redox reactions*(*electron transfer*)	application of the *donor-acceptor principle* to *redox reactions*(*electron transfer*)		
P 2.1 Knowledge acquisition 10 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10 11 P 2.2 Communication 4		
explain energy phenomena in chemical reactions by converting some of the energy stored in substances into other forms of energy (*light, heat, sound*)	explain energy phenomena in chemical reactions by converting some of the energy stored in substances into other forms of energy (*light, heat, sound*)	explain energy phenomena in chemical reactions by converting some of the energy stored in substances into other forms of energy (*light, heat, sound*)		

Topics				
Contents				
Competencies *Learners can* G(Basic level)		M(Intermediate level)	E(Advanced level)	**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
P 2.1 Knowledge acquisition 1 2 P 2.2 Communication 4, 5, 6, 8 P 2.3 Evaluation 2,7 F Physics Energy		P 2.1 Knowledge acquisition 1 2 P 2.2 Communication 4, 5, 6 8 P 2.3 Evaluation 2,7 F Physics Energy	P 2.1 Knowledge acquisition 1.2 P 2.2 Communication 4, 5, 6, 8 P 2.3 Evaluation 2,7 F Physics Energy		
9. Obtaining metals in laboratories and technology by reactions of oxides with base metals or carbon 10. Environmental damage by metal extraction 11. Significance and limits of recycling in everyday life and in laboratories 12. Cost- and energy aspects					
Presentation of the procedure of the industrial extraction of raw materials to its utilization by means of a selected substance (e.g. table salt)		Presentation of the procedure of the industrial extraction of raw materials to its utilization by means of a selected substance (e.g. table salt, iron, copper)	Presentation of the procedure of the industrial extraction of raw materials to its utilization by means of a selected substance (e.g. table salt, iron, copper)	• Experiment: Thermite process • Blast furnace process	Excursion to the blast furnace in Meyerton or to a steel plant (P,J)
P 2.1 Knowledge acquisition 1 2,4 P 2.2 Communication 1, 2, 3 6,8 P 2.3 Evaluation 1, 6, 8, 10 L VB		P 2.1 Knowledge acquisition 1, 2,4 P 2.2 Communication 1, 2, 3 6,8 P 2.3 Evaluation 1, 6, 8, 10 L VB	P 2.1 Knowledge acquisition 1 2,4 P 2.2 Communication 1, 2, 3, 6 8 P 2.3 Evaluation 1, 6, 8, 10 L VB		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
G(Basic level)	M(Intermediate level)	E(Advanced level)		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
IV. Water as the basis of life(~5 double periods)				
1. Qualitative analysis and synthesis of water 2. Properties of water 3. Properties and detection methods of hydrogen 4. Functional use of water				
Describe the distinctive features of water P 2.1 Knowledge acquisition 1 P 2.2 Communication 3 P 2.3 Evaluation 1,2	Describe the distinctive features of water P 2.1 Knowledge acquisition 1 P 2.2 Communication 3 P 2.3 Evaluation 1,2	Describe the distinctive features of water P 2.1 Knowledge acquisition 1 P 2.2 Communication 3 P 2.3 Evaluation 1,2	Project: Water - the vital compound	SIEMENS - experiment boxes (J,K,P)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
V. Discontinuity in the structure of substances and use of symbols(~10 double periods)				
1. Quantitative laws in chemical reactions 2. Law of the conservation of mass 3. Law of constant mass ratios				
describe the chemical reaction as a rearrangement of particles	describe the chemical reaction as a rearrangement or more specifically, as a transformation of particles (*atoms, molecules, ions*)	Explain the chemical reaction as a rearrangement or more specifically as a transformation of atoms, molecules and ions through breaking or forming bonds.		
P 2.1 Knowledge acquisition 10 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10 11 P 2.2 Communication 4, 5	P 2.1 Knowledge acquisition 10 11 P 2.2 Communication 4, 5		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	explain the connection between *masses* and *conservation of atomic number* in chemical reactions	explain the connection between *masses* and *conservation of atomic number* in chemical reactions		
	P 2.1 Knowledge acquisition 1,2,3,4,5,6,7,8,11 P 2.2 Communication 4, 5 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 1,2,3,4,5,6,7,8,11 P 2.2 Communication 4, 5 P 2.3 Evaluation 1	Experiment: Reaction of sulphur with copper (quantitative)	
Conduct an experiment on *mass conservation* in chemical reactions and describe the concept of mass conservation.	Conduct an experiment on mass conservation in chemical reactions and describe the concept of *mass- and atomic number conservation* (*law on mass conservation*)	Conduct and with guidance evaluate experiments on mass conservation in chemical reactions to determine the mass relationship (*law of mass conservation, law of constant mass ratios, empirical formula*)	Experiment: Reaction of sulphur with copper (quantitatively)	
P 2.1 Knowledge acquisition 1, 2,3,5,6,7	P 2.1 Knowledge acquisition 1,2,3,5,6,7,8,11 P 2.2 Communication 4, 5	P 2.1 Knowledge acquisition 1,2,4,5,6,7,8 P 2.2 Communication 4, 5		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
Explain the information content of a chemical formula (*empirical formula, molecular formula)* P 2.1 Knowledge acquisition 11 P 2.2 Communication 4 P 2.3 Evaluation 4,5	Explain the information content of a chemical formula (*empirical formula, molecular formula, structural formula)* P 2.1 Knowledge acquisition 11 P 2.2 Communication 4 P 2.3 Evaluation 4,5			

4. Development of a simple atomic representation according to Dalton's
5. interpretation of mass laws using atomic hypothesis
6. discontinuity of matter
7. size- and number ratios in the range of minute particles
   - atomic masses and atomic mass units (unit symbol u)
   - AVOGADRO-constant NA
8. atomic symbols
9. elementary groups as the most simple groups, from which structuring a substance is imaginable.
   - Elementary group symbols (ratio formula)
   - Establish simple reaction schemes

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
Compare the size of particles (*atoms, molecules*), particle groups (*Nano particles*) and everyday items.	Compare the size of particles (*atoms, molecules*), particle groups (*Nano particles*) and macroscopic objects.	Compare the size of particles (*atoms, molecules, macro-molecules*), particle groups (*Nano particles*) and macroscopic objects.	Project: Nano-chemistry	Hollow-Fibre-Membrane (J)
P 2.1 Knowledge acquisition 8 P 2.2 Communication 3	P 2.1 Knowledge acquisition 8 P 2.2 Communication 3	P 2.1 Knowledge acquisition 8 P 2.2 Communication 3		
	Determine simple ratio formulas by means of the octet rule	Determine ratio- and molecular formulas by means of the octet rule		
	P 2.1 Knowledge acquisition 4, 10 P 2.2 Communication 2, 4	P 2.1 Knowledge acquisition 4, 10 P 2.2 Communication 2, 4		
Present simple chemical reactions in *reaction schemes*	Present simple chemical reactions in *reaction schemes* and in a simplified symbol notation (e.g. Al + O2 → Al/O)	Present simple chemical reactions in *reaction schemes* and symbol notation	Games in chemistry lessons	
P 2.2 Communication 4	P 2.2 Communication 4	P 2.2 Communication 4,5		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
G(Basic level)	M(Intermediate level)	E(Advanced level)		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
With assistance, set up *reaction equations* in given reactants and products (*formula notation*)	With assistance set up *reaction equations* in given reactants and products (*Formula notation)*	Set up reaction equations *(Formula notation)*		
P 2.2 Communication 4, 5	P 2.2 Communication 4, 5	P 2.2 Communication 4, 5		
VI. Atomic structure and periodic system(~10 double periods)				
1. Development of the following conceptions: • Salts are composed of electronically charged particles, namely ions (crystal lattice) • Metal ions are electrically positively charged. • Non-metallic ions are electrically negatively charged. • Ions can carry different multiples of the smallest charges (elementary charges). 2. Development of a new atom conception: • Atoms are not indivisible. • Atoms contain electrically positive and negative components. • Negative components (electrons) can be emitted and absorbed by atoms (ionization).				
Name substance particles (*atoms, molecules*) as	Describe and assign *groups of atoms, molecules and*	Describe and assign *groups of atoms, molecules and ions*	• Project: Historical analysis of	SIEMENS Experiment boxes (J,K,P)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
building blocks of substances	*ions* to the relevant pure substances	to the relevant pure substances	atomic models (file, presentation) • Work with models • Comparative analysis of the model representations • Create a mind map • Create posters (atomic structure, PSE)	Edition of the DSK basic knowledge formulary (K)
P 2.1 Knowledge acquisition 10	P 2.1 Knowledge acquisition 10, 11	P 2.1 Knowledge acquisition 10, 11		
	Carry out and evaluate an experiment on *electrolysis* of a metal-salt solution (*principle of an electrochemical energy reservoir*)	Carry out and evaluate an experiment on *electrolysis* of a metal-salt solution (*principle of an electrochemical energy reservoir*)		
	P 2.1 Knowledge acquisition 1,6,7 P 2.2 Communication 4, 7, 8 10 P 2.3 Evaluation 1, 2, 6, 10 F Physics Energy L BNE, VB	P 2.1 Knowledge acquisition 1 6,7 P 2.2 Communication 4, 7, 8 10 P 2.3 Evaluation 1, 2, 6, 10 F Physics Energy L BNE, VB		
Describe *ionic bonds* and thereby the typical properties of salts (*brittleness, high melting temperature, electrical conductivity*)				

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
P 2.1 Knowledge acquisition 10,11 P 2.2 Communication 3 P 2.3 Evaluation 1,2			• Film: Rutherford scattering or Animation Chemistry interactively to the scattering experiment: http://www.chemie-interaktiv.net/ff.htm • Create a film protocol	
	describe the nuclear envelope model on the basis of *RUTHERFORD'S scattering experiment*	describe *RUTHERFORD'S SCATTERING MODEL* and explain the experiment results in view of the development of the nuclear envelope model		
	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4, 5 P 2.3 Evaluation 4	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4, 5 P 2.3 Evaluation 4		
	Explain the structure of atoms and ions by means of an atomic model (*proton, electron, neutron, nuclear-envelope-model, shell model, outer electron, ion formation, noble gas configuration*)	explain the structure of atoms and ions by means of an atomic model (*proton, electron, neutron, nuclear-envelope-model, shell-/energy level model, outer electron, atomic core, ion formation, ionisation energy, noble gas configuration*)		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 1, 2, 3, 4 P 2.3 Evaluation 2 F Physics: Structure of matter	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 1, 2, 3, 4 P 2.3 Evaluation 2,5 F Physics: Structure of matter		
3. Definitions of oxidation and reduction as electron emission/ electron absorption 4. The atomic shell model 5. The periodic system of elements 6. The similarity of chemical properties in elements of a main group is due to the similar structure of the outer electron shell of its atoms. 7. The Octet rule				
name the *atomic symbols* of important elements	Explain the connection between atomic structure and position of atoms in the periodic system (atomic symbols, *order number, proton number, electron number, neutron number, mass number, outer electrons, main group, period*)	Explain the connection between atomic structure of elements and their position in the periodic system of elements (atomic symbols, ordinal numbers, number of protons, number of electrons, number of neutrons, mass number, outer electrons, main group, period, MENDELJEW)	• Create a film protocol Mendelejew	

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
P 2.1 Knowledge acquisition 4	P 2.1 Knowledge acquisition 4,8,11 P 2.2 Communication 1, 2, 3 4,5 P 2.3 Evaluation 2	P 2.1 Knowledge acquisition 4 8,11 P 2.2 Communication 1, 2, 3, 4 5 P 2.3 Evaluation 2		
	Arrange substances according to their substance particles (*metals, noble gases, volatile/molecular substances, salts*)	Arrange substances according to their substance particles (*metals, noble gases, volatile/molecular substances, salts*)		
	P 2.1 Knowledge acquisition 10, 11	P 2.1 Knowledge acquisition 10, 11		
Explain the connection between atomic structure and position of the atoms in the *periodic table of elements* (*ordinal number, number of protons, number of electrons, number of neutrons, mass number, outer electrons, main group, period*				

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
P 2.1 Knowledge acquisition 4,8,11 P 2.2 Communication 1, 2, 3,4.5 P 2.3 Evaluation 2				
Explain the structure of atoms and ions by means of a model (*proton, electron, neutron, nuclear-envelope-model, shell model, outer electron, ion formation, noble gas configuration*)				
P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 1, 2, 3, 4 P 2.3 Evaluation 5 F Physical Science Structure of matter				

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
G(Basic level)	M(Intermediate level)	E(Advanced level)		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
VII. Table salt and other salts(~7 double periods				
1. History and cultural significance, occurrence, properties and use of table salt 2. Table salt production 3. Identifying table salt as sodium chloride 4. Properties of chlorine and sodium 5. Synthesis of sodium chloride 6. Halogens as family of elements 7. Alkali metals as family of elements 8. Reaction of metals with halogens: Synthesis of binary salts				
	Describe ionic bonds and thereby justifying the typical properties of salts and salt solutions(*brittleness, high melting temperature,*	Describe ionic bonds and thereby justifying the typical properties of salts and salt solutions(*brittleness, high melting temperature, electrical*	• Learner experiment: Conduct and describe a proof for alkali metals (flame coloration) • Teacher demonstration experiment:	

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	electrical conductivity)	*conductivity*)	Sodium + water • Learner experiment: Conduct and describe a test for alkaline earth metals (flame coloration)	
	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 3 P 2.3 Evaluation 1,2 F Physics Electrical Science, Charge	P 2.1 Knowledge acquisition 10 11,12 P 2.2 Communication 3 P 2.3 Evaluation 1, 2, 5 F Physics Electrical Science, Charge	• Film protocol: Reaction of sodium and chlorine • Learner experiment: Growing crystals	
		Describe the solution procedure of salts at *particle level* (*Hydratation)*	• Learner experiment: Properties of salts (solubility, conduction etc.) • Group work: “Ion-Memory”	
		P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4	• Create a "table salt” profile: Everyday, technology, significance as a resource in the chemical industry	
	Describe the metal bonding and thereby justify the typical properties of metals (*deformability, electrical conductivity*)	Describe the metal bonding and thereby justify the typical properties of metals (*deformability, electrical conductivity*)		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 3 P 2.3 Evaluation 1,2 F Physics Electrical Science	P 2.1 Knowledge acquisition 10 11,12 P 2.2 Communication 3 P 2.3 Evaluation 1, 2, 7 F Physics: Basic sizes in electrical science		

VIII. Molecules and Electron pair bonding (~5 double periods)

1. The common characteristics of gaseous substances.
   - There is a lot of space between the particles of a gas.
   - The gas particles are constantly moving.
   - Equal volumes of all gases change in the same way
   - If subjected to temperature- and pressure changes.
   - Definitions and standard conditions (273 K; 1013 hPa)
2. Avogadro's law
   - The volume of a gas portion with NA = 6,023 x 1023
   - Particles (molar volume) under standard conditions, is V - 22, 4 L.
3. The smallest particles of base elementary gases are di-atomic molecules, of noble gas atoms.
4. Electron pair bonds according to Lewis single-, double- and triple bonds
5. Connection between polar atomic bonding and electronegativity
6. Arrangement of substances according to their substance particles (*metals, noble gases, molecular substances, salts*)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
Explain molecule formation by *electron pair bonding* using the *octet rule*	Explain molecule formation by electron pair bonding using the *octet rule* (*bonding and non-bonding electron pairs, LEWIS notation, single- and double bonds)*	Explain molecule formation by electron pair bonding using the *octet rule* (*bonding and non-bonding electron pairs, LEWIS notation, single- and multiple bonds)*	Experiments on solubility	
P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4	P 2.1 Knowledge acquisition 9, 10, 11, 12 P 2.2 Communication 3, 4		
	compare *polar* und *non-polar electron pair bonds* (*electron negativity*)	compare *polar* und *non-polar electron pair bonds* (*electron negativity*)		
	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4	P 2.1 Knowledge acquisition 9, 10, 11, 12 P 2.2 Communication 3, 4		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
			Molecule building set	
		Explain the chemical reaction as a rearrangement or more specifically as a transformation of atoms, molecules and ions through breaking or forming bonds.		
		P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4, 5		
		derive possible intermolecular interactions from the structure of two molecules		
		P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	explain the special characteristics of water (*high boiling temperature, hydrogen bridges*)	Explain the special characteristics of water (*negative thermal expansion, high boiling temperature, spacial structure of a hydrogen molecule, hydrogen bridges*)		
	2.3 Evaluation 7	2.3 Evaluation 7		
	explain the physical properties of substances (*boiling- and melting temperature*) based on intermolecular interactions	explain the physical properties of substances (*boiling- and melting temperature, solubility*) based on intermolecular interactions		
	P 2.1 Knowledge acquisition 10 P 2.2 Communication 4, 6 P 2.3 Evaluation 7	P 2.1 Knowledge acquisition 10 P 2.2 Communication 4, 6 P 2.3 Evaluation 7		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
G(Basic level)	M(Intermediate level)	E(Advanced level)		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
	Represent the connection between bond type and *dipole-properties* of water	Represent the connection between bond type, spacial structure and *dipole-properties of molecules* (H_2, *HCl*, CO_2, H_2O, NH_3)	Learner experiment: Water deflection by static charge	
	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4 P 2.3 Evaluation 1		
	Assign substance particles (*electron pair bonding, ion bonding, metal bonding*)	Assign pure substances (*electron pair bonding, ion bonding, metal bonding*)		
	P 2.1 Knowledge acquisition 8, 9	P 2.1 Knowledge acquisition 8, 9		
	describe intermolecular interactions *VAN-DER-WAALS-interactions, dipole-interactions, hydrogen bridges*)	describe intermolecular interactions *VAN-DER-WAALS-interactions, dipole-interactions, hydrogen bridges*)		
	P 2.1 Knowledge acquisition 10 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4		
IX. Acids and bases – acid and alkaline solutions – acid-forming oxide (~8 double periods)				

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements**
G(Basic level)	M(Intermediate level)	E(Advanced level)		K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
1. Proton donors are called acids. 2. Acidic solutions are corrosive, contain oxonium ions and give indicator solutions characteristic colours. 3. Different acidic solutions react with base metals in the same way when producing hydrogen. 4. Noble metals do not react with oxonium-ions. 5. Proton acceptors are called bases. 6. Alkaline solutions contain hydroxide ions, are corrosive and give indicator solutions characteristic colours. 7. Metals of the two main groups and their oxides react with water to form alkaline solutions. 8. The reaction between oxonium ions and hydroxide ions is called neutralisation. 9. Non-metals (sulphur oxide, sulphur trioxide, nitrogen oxide and carbon dioxide) react with water to form acidic solutions. 10. Important acids: Hydrochloric acid, sulfuric acid, nitric acid, carbonic acid, important organic acids. 11. Toxic effects of acid-forming oxides				
Investigate the properties of aqueous solutions (electrical conductivity, acid, alkaline,			• Experiments: Preparation of red cabbage indicator	SIEMENS Experiment boxes (J,K,P)

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
neutral) and allocate the technical terms acid, alkaline and neutral to the pH-scale. P 2.1 Knowledge acquisition 1 P 2.2 Communication 5, 6			• pH-measurements • Use of applications: Hydrations and lattice energy • Learner test: Reaction of ions (indicators) • Use of models: donor-acceptor-principle Learner experiments: • Reaction of hydrogen chloride with water • Fountain experiment (ammonia with water) • Titration with sodium hydroxide solution with hydrochloric acid • Reaction of calcium carbonate with hydrochloric acid • Reaction of magnesium with hydrochloric acid	
Name examples for *alkaline and acidic solutions* (*sodium hydroxide solution, hydrochloric acid, calcium carbonate solution*) P 2.3 Evaluation 1,2				
Use of the *Universal indicator* for identification of neutral, acidic and alkaline solutions (*neutralisation*) P 2.1 Knowledge acquisition 1, 2,5,6,7,8				
Name combinations of important substance properties (*magnesium,*	Name combinations of important substance properties (*sodium, sodium*	Name combinations of important substance properties (*sodium, sodium*		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
sodium, sodium hydroxide)	*hydroxide*)	*hydroxide*)		
P 2.1 Knowledge acquisition 4 P 2.2 Communication 2, 3	P 2.1 Knowledge acquisition 4 P 2.2 Communication 2, 3	P 2.1 Knowledge acquisition 4 P 2.2 Communication 2, 3		
	Investigate the properties of aqueous solutions (*electrical conductivity, acid, alkaline, neutral*) and allocate the technical terms acid, alkaline and neutral to the pH-scale.	Investigate the properties of aqueous solutions (*electrical conductivity, acid, alkaline, neutral*) and allocate the technical terms acid, alkaline and neutral to the pH-scale.		
	P 2.1 Knowledge acquisition 1 P 2.2 Communication 4 -6	P 2.1 Knowledge acquisition 1 P 2.2 Communication 4 -6		
Name further examples for *alkaline solutions*(*ammonia solution*)	Name examples for *alkaline and acidic solutions* (*sodium hydroxide solution, hydrochloric acid, calcium carbonate solution*)	Name examples for *alkaline and acidic solutions* (*sodium hydroxide solution, hydrochloric acid, calcium carbonate solution*)		
	P 2.3 Evaluation 1, 7	P 2.3 Evaluation 1, 7		
Describe *ion groups* as substance particles and assign *atoms, molecules and ion groups* to the corresponding				

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
pure substances				
P 2.1 Knowledge acquisition 10, 11				
Assign the corresponding particles to acid and alkaline solutions (*oxonium- and hydroxide ion*)	Assign the corresponding particles to acid and alkaline solutions (*oxonium- and hydroxide ion*)	Assign the corresponding particles to acid and alkaline solutions (*oxonium- and hydroxide ion*)		
P 2.2 Communication 4	P 2.2 Communication 4	P 2.2 Communication 4		
		Explain the *donor-acceptor-principle* and use in *acid-base reaction* (*proton transition, neutralisation)*		
		P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4		
Perform and describe a test for selected ions (*oxonium- and hydroxide ions)*	Perform and describe a test for selected ions (*oxonium- and hydroxide ions)*	Perform and describe a test for selected ions (*oxonium- and hydroxide ions)*		
P 2.1 Knowledge acquisition 1, 2,5,6,7	P 2.1 Knowledge acquisition 1,2,5,6,7	P 2.1 Knowledge acquisition 1, 2,5,6,7		
	Use of *indicators* for	Use of *indicators* for		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	identification of neutral, acid and alkaline solutions (*a plant dye, universal indicator, neutralisation*)	identification of neutral, acid and alkaline solutions (*a plant dye, universal indicator, phenolphthalein or thymolphthalein solution, neutralisation*)		
	P 2.1 Knowledge acquisition 1, 2,5,6,7,8	P 2.1 Knowledge acquisition 1, 2,5,6,7,8		
		Perform calculations and ensure correct use of *quantity, units* (*atomic mass, particle number, density*, *mass portion, concentration of substance in a solution.*)		
		P 2.1 Knowledge acquisition 4 P 2.2 Communication 2, 5 F Mathematics		
		Perform and evaluate a titration		
		P 2.1 Knowledge acquisition 1, 2,3,5,6,7 P 2.2 Communication 10		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
X. Carbon - an important element(~10 double periods)				
1. Properties and structure of the allotropes of carbon 2. Carbon dioxide and carbonic acid 3. Salts of carbonic acid: • Carbonates and hydro-carbonates • Natural and technical lime cycle 4. The greenhouse effect (natural and anthropogenic) carbon dioxide and gases other than greenhouse gases 5. Worsening of the greenhouse effect by the formation of carbon dioxide in the combustion of fossil fuels 6. Influence of man on the carbon dioxide concentration in the atmosphere and possible effects on the climate				
Name the use and application of *nano particles*	Describe the change of substance characteristics subject to particle size by means of an example (*nano particles*)	Describe the change of substance characteristics subject to particle size by means of an example (*nano particles*) and the connection to the surface/volume ratio.		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
P 2.1 Knowledge acquisition 2 P 2.2 Communication 1, 2 P 2.3 Evaluation 1,5	P 2.1 Knowledge acquisition 2,8,11 P 2.2 Communication 1, 6 P 2.3 Evaluation 5, 11	P 2.1 Knowledge acquisition 2 8,11 P 2.2 Communication 1, 6 P 2.3 Evaluation 5, 11		
Describe the *carbon cycle* in living nature and evaluate the impact of human intervention	Describe the *carbon cycle* in living nature and evaluate the impact of human intervention	Describe the *carbon cycle* in living nature as a system of chemical reactions and evaluate the impact of human intervention		
P 2.2 Communication 3, 4, 5, 6 P 2.3 Evaluation 2, 6, 9, 10 L BNE	P 2.2 Communication 3, 4, 5, 6 P 2.3 Evaluation 2, 6, 9, 10 F Biology: Ecology L BNE	P 2.2 Communication 3, 4, 5, 6 P 2.3 Evaluation 2, 5, 6, 9.10 F Biology: Ecology L BNE		
	Explain the structural principle of *macro molecules* by means of an example	Explain the structural principle of *macro molecules* by means of an example		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4	P 2.1 Knowledge acquisition 10, 11 P 2.2 Communication 4		
XI. Introduction to Organic Chemistry (~30 double periods)				

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
$G_{(Basic\ level)}$	$M_{(Intermediate\ level)}$	$E_{(Advanced\ level)}$		

1. Qualitative analysis of organic bonds

2. Natural gas and crude oil

- Formation
- Components; separation of the components (distillation)
- Economic use

3. Unsaturated hydrocarbons

- Molecular formulas
- Physical and chemical properties
- Homologous series
- Isomerism/nomenclature
- Reaction with halogens/addition reaction

5. Alkanals and alkanones - aldehydes and ketones

- Oxidation of alkanols
- Oxidation numbers and redox diagrams

4. Alkanols

- Alcohol as a culture drug and alcohol abuse
- Molecular formulas
- Production
- Properties
- Application
- Connection between structure and properties
- Property in the homologous series of alkanols.
- Structural isomerism
- Nomenclature
- Nucleophilic substitution
- Primary, secondary, tertiary and multivalent alkanols
- Nomenclature of aldehydes and ketones
- Properties, detection-reactions and use

6. Organic acids and esters

- Preparation by oxidation of primary alkanols and alkanals
- Properties and use
- Nomenclature
- Chemical equilibrium and mass action law

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
• Inductive effect and mesomerism		• Acidity of the carboxyl group • Alkanedioic acids and substituted alkanoic acids • Ester condensation and ester hydrolysis • Properties and use of esters		
	Explain the use of selected organic substances, on the basis of their properties, in everyday life and technology (*natural gas, ethene*,*ethanol, acetic acid*)	Explain the use of selected organic substances, on the basis of their properties, in everyday life and technology (methane, ethene,*ethanol, acetone, acetic acid*)		
	P 2.1 Knowledge acquisition 4 P 2.2 Communication 3, 6, 7 P 2.3 Evaluation 1, 6, 7 L VB	P 2.1 Knowledge acquisition 4 P 2.2 Communication 3, 6, 7 P 2.3 Evaluation 1, 6, 7 L VB		
Describe the change of substance properties within the *homologous series of alkanes*	Describe the change of substance properties within a homologous series (*homologous row of alkanes and alkanols*)	Describe the change of substance properties within a homologous series (*homologous row of alkanes and alkanols*)		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
P 2.1 Knowledge acquisition 8, 9 P 2.2 Communication 1, 3	P 2.1 Knowledge acquisition 8, 9 P 2.2 Communication 1, 3	P 2.1 Knowledge acquisition 8, 9 P 2.2 Communication 1, 3		
Assess the dangers of alcohol consumption				
P 2.2 Communication 9 P 2.3 Evaluation 6, 11 F Biology P PG, VB				
Describe the oxidation of ethanol	Describe the oxidation of organic substances (*ethanol* to *acetic acid*)	Represent the oxidation of organic substances by means of structural formulas and reaction equations (*alkanol* via *alkanal* to *alkanoic acid*)		
P 2.1 Knowledge acquisition 1, 2 P 2.2 Communication 4 L 2.3 Evaluation	P 2.1 Knowledge acquisition 1, 2 P 2.2 Communication 4 P 2.3 Evaluation 1	P 2.1 Knowledge acquisition 1, 2 P 2.2 Communication 4 P 2.3 Evaluation 1		

Topics				
Contents				
Competencies *Learners can*			**Methods curriculum**	**School-specific additions and enhancements** K: Cape Town, J: Johannesburg P: Pretoria, W: Windhoek
G(Basic level)	M(Intermediate level)	E(Advanced level)		
Explain organic substances on the basis of typical properties and the use in everyday life and technology (*methane, gasoline, heptane, ethene*)	Describe organic substances on the basis of typical properties (*methane, heptane, ethene, ethanol, acetic acid*)	Describe organic substances on the basis of typical properties (*methane, heptane, ethene, ethanol, acetic acid*)		
P 2.1 Knowledge acquisition 1, 2, 4, 6 P 2.2 Communication 1 P 2.3 Evaluation 1 P VB	P 2.1 Knowledge acquisition 2 4 P 2.2 Communication 1, 4, 6 P 2.3 Evaluation 1, 11	P 2.1 Knowledge acquisition 1, 2, 4, 6 P 2.2 Communication 1, 4, 6 L 2.3 Evaluation 1, 11		

1. Sample Questions

Competence-oriented teaching requires tasks, which in addition to subject knowledge, also take into account the other areas of competence. The new emphasis is therefore on knowledge acquisition, communication and evaluation. The following aspects need to be considered in task-setting:

- Funded competencies
- Required knowledge
- Task context
- Characteristics, which are interesting and motivating for learners [9]

However, for many learners, task set up in this way are too difficult; therefore internal differentiation measures should always be included in order to ensure successful solving.

The tasks below consist of 4 parts respectively (compare [10]):

- First the problem or the material is presented.
- Then the concrete task follows.
- The relevant competences are assigned to the task.
- In the last section, there are hints on how to implement the task in the lessons.
- (e.g. possible solutions, hints on internal differentiation).

1.1. Sample Question 1

Gas evolution in effervescent (fizzy) tablets (Grades 7/8)
[10 - 11]

Problem
During the cold season, we occasionally try to strengthen our immune system with vitamins in fizzy tablets. This is also an opportunity for physical and chemical examinations. You can observe the dissolution of the fizzy tablet individually or in a team and investigate more closely.

Materials:

- For practical work: Goblets, pneumatic tub or similar, stand- or measuring cylinders, test tubes, balloons, fizzy tablets, stop watch, candles
- For the additional task: Film- or fizzy tablet tubes (e.g. valves, drinking straws, etc.), polystyrene or similar.

Formulation of task:	Competencies
a) set up and conduct experiments, to identify the gas, which is formed during dissolving the fizzy tablet.	• describe typical characteristics (F). • compile questions (E). • set up appropriate tests (E). • perform qualitative experiments and record them (E) • factually explain the presence of substances by the applied work techniques (E). •

b) One, two or three fizzy tablets are dissolved in water - one after the other. Plan and conduct an experiment to determine the gas volume accurately.	• Plan appropriate studies to verify hypothesis (E). • perform qualitative experiments and record them (E) • Record readings (K).
c) Develop a founded assumption on surprising observations, discuss and interpret them.	• record work stages and results (K) • Reason technically correct and logical (K) • include their classmates' contributions in their representations (K) • report their results (K)
Additional task: Build a rocket boat with jet propulsion.	• Choose appropriate technical information on the problem (B) • Solve complex tasks in small groups (K).

Notes:
Learners are expected to create a protocol on the experiment independently.

On (a)

Hypothesis: The gas produced is oxygen, carbon dioxide, nitrogen or hydrogen.

When the learners have selected and described suitable methods for verification, they conduct the experiment according to their plan.

On (c)

For learners it is a surprising observation, that when two or three fizzy tablets are dissolved, more than double or even three times the gas volume is produced.

Hypothesis: A part of the gas produced, dissolves in water.

This task reveals, whether learners have the competency to develop a hypothesis and proposals for experimental verification. The experimental verification of proposals can be carried out or discussed initially, to clarify the connection with the appropriate explanation. [12].

Suggestions for internal differentiation:
If necessary, a table on the solubility of gases in water should be provided. For example:

Name of the gas	Maximum solubility In g/L at 20°C
Carbon dioxide	About 1.7
oxygen	0.044
nitrogen	0.019

Depending on the performance level of learners, the observations on gas volume can be visualised in table form or as a diagram and critically reflected. Weaker learners should refrain from solving partial task c), but receive assistance in solving additional task "

1.2. Sample Question 2

How can a coffee percolator best be decalcified? (Grade 9)

Problem

If tap water is heated, it evaporates. A white soluble deposit remains. If the percolator is used over a longer period of time, soon white deposits show. This happens whenever water is heated. Containers and appliances are calcified.

The deposits in the percolator have to be removed as they damage metallic water pipes (they "corrode"). They will start leaking and water will come into contact with electrical wires inside the machine - a dangerous situation causing fires or electric shock to the user. In addition, more energy is needed to heat up calcified appliances.

To de-calcify household appliances various decalcifiers are available.

Materials:

- For practical work: Test tubes, gas burners, various commercially available decalcifiers, citric acid, hydrochloric acid, acetic acid, boiler stone, marble or calcium carbonate

Formulation of task:	Competencies The learners...
a) Gain an overview of chemicals used for decalcifying	• Do research in different sources (E). • Differentiate between relevant and irrelevant information (E). • Differentiate substance categories and derive possible implementation(F)
b) Develop a series of tests, to show how decalcifiers work. Conduct these experiments and assess them.	• Systematically plan a series of tests with appropriate procedures (E). • perform experiments independently and record them (E) • reflect on the chosen test methods and discuss the significance of the results • Apply working techniques properly (E). • Create reaction schemes (F)
c) Evaluate the suitability of a commercially available descaler for decalcifying a coffee percolator. Pay particular attention to reaction conditions that occur when the descaler passes through the coffee percolator. Carry out appropriate experiments.	• solve complex tasks in small groups (K). • Systematically plan test series with appropriate procedures (E). • Reason technically correct and logical (K) • Use the subject knowledge acquired in the lessons Problem- and decision-making-situations (V)
d) Present the results of your work	• Present the results by using appropriate media and self-designed materials (K).

Notes:

Learners should be allocated to performance heterogeneous groups. Learners are expected to create protocol

on the experiment independently.

On (a)
Commercially available decalcifiers contain an important component for decalcification which is an organic acid, mostly citric acid, while in more expensive agents, amidosulfonic acid is used.

On (b)
During decalcification, oxonium ions react with the calcium carbonate Thus, actually each acidic solution is suitable. The independent planning of a test series indicates a higher level of competence.

On (c)
When heated, a solution containing citrate ions and calcium ions, forms solid calcium citrate, which is hardly soluble. Learners have to heat the respective solutions. Solving of this task independently points to a higher level of competency; the corresponding differentiated aids should enable learners to successfully solve the tasks.

Suggestions for internal differentiation:
Differentiated aids should be supplied.

Example:

Exercise b)

Note 1:
Commercially available decalcifiers contain citric acid. In the laboratory and in many households, hydrochloric acid, sulfuric acid and acetic acids are also available.

Note 2:
The gas produced is examined with lime water.

Note 3:
In a chemical context, "lime" is a calcium carbonate CaCO3. The compound consists of calcium- and carbonate ions.

Note 4:
The chemical formulas of the acids or acidic solutions to be used are:

- HCit for citric acid,
- H3O+ + Cl- for diluted hydrochloric acid,
- H3O+ + SO_4^{2-} for diluted sulfuric acid

Note 5:
Equipment and chemicals:
4 test tubes, test tube holder;
Calcium carbonate ("lime") diluted citric acid and acetic acid solutions, diluted hydrochloric acid, diluted sulfuric acid, universal indicator solution, lime water.

Procedure:
A small portion of calcium carbonate is added to the test tubes. The various acids are added to one of the test tubes respectively.

Exercise c)

Note 1:
Coffee is prepared with hot water. During boiling the coffee, the water is heated rapidly!

Note 2:
In households, some appliances and various objects are freed from lime in a cold state; others, like the coffee percolator, must be decalcified in a hot state.

Note 3:
Heat the mixtures of your test series for a short time.

2. List of commands

2.1. Standard

Specific requirements I	
deduce	reach a conclusion from the information given
choose	be able to take a well-founded decision
name/label	Assign specific terms to criteria according to instructions
observe	consciously perceive with the own senses or read from measuring instruments
describe	provide a detailed and structured description of structures, phenomena, processes and properties of objects by using subject terminology
outline/present	Describe the main features, structure or general principles in a structured way
perform	Carry out pre-scribed or own instructions (e.g. for experiments or a work assignment)
Recognize	cognitive process of abstraction in which a perception is assigned to a term or concept; this process is only operational in observable follow-up actions
list/give	Name elements, phenomena, names/terms or facts without explanations
use	Implement in a technically correct way
write a lab report/data log:	Write down procedures, observations and results/discussions and conclusions (if applicable) following scientific rules

Specific requirements II	
apply	apply a known context or method to a different phenomenon
formulate(reaction equation)	Formulate a reaction equation stoichiometrically balanced in symbolic notation
determine/calculate	generate a result from data given (graphically or experimentally)
explain	give a detailed account of causes, reasons or mechanisms to elucidate structures, processes and relationships
explain	Capture structures, processes, correlations etc. of a phenomenon and attribute to general statements/laws and make them understandable by additional information or examples
assign-/arrange in order	Arrange specific terms, objects etc. systematically/in proper order/groups-based according to existing principles or certain features.
plan	Develop ways to solve a specific problem
investigate/examine	targeted exploration of phenomena or objects, identify features and correlations
compare	Identify similarities and differences

Specific requirements III	
analyse	put data, individual results or other aspects in context, in order to draw conclusions
justify/give reasons	put phenomena down to underlying rules, laws and causal relationships
evaluate	Substantiated assessment of a phenomenon according to subject-related or subject-methodological criteria or personal and social values

2.2. English list of commands

Operator	Command term	Beschreiben der erwarteten Leistung	Expectation	Example	AFB
ableiten *(nur Physik und Biologie)*	deduce	auf der Grundlage von Erkenntnissen sachgerechte Schlüsse ziehen	reach a conclusion from the information given	Deduce from the data the necessity to expand the Rutherford atom model.	II
abschätzen *(nur Physik und Biologie)*	estimate	durch begründete Überlegungen Größenordnungen angeben	find an approximate and reasonable value for an unknown quantity	Estimate whether a 10A fuse would be sufficient in the given situation.	II
analysieren	analyse and identify	systematisches Untersuchen eines Sachverhaltes, bei dem Bestandteile, deren Merkmale und ihre Beziehungen zueinander erfasst und dargestellt werden	investigate phenomena/data/etc. systematically considering and representing parts/features and relationships/connections	Analyse the setup of the experiment and identify possible sources of errors.	II
anwenden	apply	einen bekannten Zusammenhang oder eine bekannte Methode auf einen anderen Sachverhalt beziehen	use a known idea, equation, principle, theory or law in a new situation	Apply the induction law to the situation given.	II
Aufstellen von Hypothesen	propose a hypothesis	eine begründete Vermutung formulieren	suggest or construct a clearly focused and justified assumption	Propose a hypothesis looking at the different physical quantities affecting the magnetic flux density of a solenoid.	III
auswerten	evaluate	Daten, Einzelergebnisse oder andere Elemente in einen Zusammenhang stellen, gegebenenfalls zu einer Gesamtaussage zusammenführen und Schlussfolgerungen ziehen	process data and results, deduce a relationship between the variables, conclude general statements and assess the implications	Evaluate the experiment's magnetic flux density of a solenoid and state the derived equation.	III
begründen	justify/give reasons	Sachverhalte auf Regeln, Gesetzmäßigkeiten bzw. kausale Zusammenhänge zurückführen	put phenomena down to underlying rules, (physical) laws and causal relationships	Justify/Give reasons why the red line of the hydrogen spectrum causes no photo effect.	III
benennen	name/label	Begriffe und Sachverhalte einer vorgegebenen Struktur zuordnen	assign the specific terms to a given structure	Name the parts of the X-ray tube.	I
berechnen	calculate	Ergebnisse aus gegebenen Werten rechnerisch generieren	insert the corresponding values into an equation and generate the result	Calculate the gravitational field strength at the equator using the mean radius of the earth and the earth medium density.	II
beschreiben	describe	Sachverhalte wie Objekte und Prozesse nach Ordnungsprinzipien strukturiert unter Verwendung der Fachsprache wiedergeben	give a detailed and structured description of something using the appropriate terminology	Describe the setup of the Milikan experiment and how it is conducted.	II
bestimmen	find	Ergebnisse aus gegebenen Daten generieren	generate a result from data given (graphically or numerically)	Find the value of the Planck constant from the diagram.	II
beurteilen, bewerten	comment on/assess	zu einem Sachverhalt eine selbstständige Einschätzung nach fachwissenschaftlichen und fachmethodischen Kriterien angeben	pass judgment on something based on scientific criteria/methods	Comment of the use of Carbon dating for age determination in the following situation.	III
beweisen *(nur Physik und Biologie*	show/reason	mit Hilfe von sachlichen Argumenten durch logisches Herleiten eine Behauptung/Aussage belegen bzw.	prove something by means of factual argumentation/reasoning by logic deduction	Show that Bohr's and De Broglie's approaches lead to the same quantum condition.	III

darstellen	outline/present	Sachverhalte, Zusammenhänge, Methoden, Ergebnisse etc. strukturiert wiedergeben	give the main features structure or general principles in a structured way	Present the results of your experiment.	I
diskutieren	discuss	Argumente zu einer Aussage oder These einander gegenüberstellen und abwägen	investigate or examine by argument, give and weigh arguments for and against something	Discuss the use of nuclear fusion as a future energy source.	III
erklären	explain	Strukturen, Prozesse, Zusammenhänge, usw. eines Sachverhaltes erfassen und auf allgemeine Aussagen/Gesetze zurückführen	give a detailed account of causes, reasons or mechanisms to illuminate structures, processes and relationships	Explain the formation of electrical surge in the following experiment.	II
erläutern	describe and explain	wesentliche Seiten eines Sachverhalts/Gegenstands/Vorgangs an Beispielen oder durch zusätzliche Informationen verständlich machen	describe and explain by giving examples	Describe and explain the formation of spectral lines of the hydrogen atom.	II
formulieren	formulate	eine Beschreibung eines Sachverhaltes oder eines Vorgangs in einer Folge von Symbolen oder Wörtern angeben	represent processes and facts verbally or symbolically	Formulate the chemical equation for…	II
herleiten *(nur Physik und Biologie)*	derive	aus Größengleichungen durch mathematische Operationen eine physikalische Größe freistellen und dabei wesentliche Lösungsschritte kommentieren	manipulate (a) mathematical relationship(s) to give a new equation/relationship commenting the main steps on the way	Derive the equation …for the wavelength λ of the electrons in the experiment of the electron diffraction on graphite from the theory.	II
interpretieren, deuten	interpret	Sachverhalte und Zusammenhänge im Hinblick auf Erklärungsmöglichkeiten herausarbeiten	find explanations for phenomena/data to reach conclusions	Interpret the shape of the U-I curve in the Franck-Hertz experiment.	III
klassifizieren, ordnen	sort/group/classify	Begriffe, Gegenstände etc. auf der Grundlage bestimmter Merkmale systematisch einteilen	arrange systematically/in proper order/groups based on existing principles or according to certain features	Group/sort the following phenomena according to the underlying theory for their explanation (the wave theory or the particle theory of light).	II
nennen	list/give	Elemente, Sachverhalte, Begriffe, Daten, Fakten ohne Erläuterung wiedergeben	give names/terms or other brief answers leaving out the explanation	List three weaknesses of the Rutherford Model.	I
planen (Experimente, *nur Physik und Biologie)*	plan	zu einem vorgegebenen Problem eine Experimentieranordnung finden und eine Experimentieranleitung erstellen	come up with a design for an experiment or a structured approach to test/investigate a problem	Plan an experiment to test whether a substance is a conductor.	III
protokollieren *(nur Physik und Biologie)*	write a lab report/data log	Ablauf, Beobachtungen und Ergebnisse sowie ggf. Auswertung (Ergebnisprotokoll, Verlaufsprotokoll) in fachtypischer Weise wiedergeben	write down procedures, observations and results/discussions and conclusions (if applicable) following scientific conventions	Write a lab report on the experiment you conducted on …	I
prüfen/überprüfen *(nur Chemie)*	test/verify	Sachverhalte oder Aussagen an Fakten oder innerer Logik messen und ggf. Widersprüche aufdecken	check facts and interrelations for quality/performance/reliability	Verify the specifications by the manufacturer using the data given.	II
skizzieren	sketch	Sachverhalte, Objekte, Strukturen oder Ergebnisse auf das Wesentliche reduzieren und in übersichtlicher Weise wiedergeben	clearly lay out facts/ structures/results by means of a graph/diagram/table etc.	Sketch the setup of the Franck-Hertz experiment.	I
untersuchen *(nur Physik und Biologie)*	investigate/examine	Sachverhalte/Objekte erkunden, Merkmale und Zusammenhänge herausarbeiten	carry out research or study into a subject so as to discover facts and information	Investigate the relation of the rotational speed and induced voltage data from the given data.	II
verallgemeinern	generalize	aus einem erkannten Sachverhalt eine erweiterte Aussage treffen	formulate/derive a general statement	Generalize the relation between induced voltage and change of area by taking into account the magnetic flux density.	II

vergleichen	compare	Gemeinsamkeiten und Unterschiede von Sachverhalten, Objekten, Lebewesen und Vorgängen ermitteln	give a criteria based account of similarities and differences between phenomena, objects, living organisms and processes	Compare the magnetic field of a bar magnet with that of a current carrying solenoid.	II
zeichnen	draw	eine exakte Darstellung beobachtbarer oder gegebener Strukturen anfertigen	create an exact graphical representation	Draw the corresponding U-I diagram.	I
zusammenfassen *(nur Physik und Biologie)*	summarize	das Wesentliche in konzentrierter Form wiedergeben	give a brief account or summary	Summarize the experimental results regarding the photoelectric effect that cannot be explained by the wave behaviour.	II