GRADE 12 PHYSICS *(MECHANICS)* TERM 1					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
13 HOURS	**<u>Momentum & Impulse</u>**				
2 HOURS	Momentum	• Define momentum • Calculate the momentum of a moving object using $p = mv$. • Describe the vector nature of momentum and illustrate with some simple examples • Draw vector diagrams to illustrate the relationship between the initial momentum, the final momentum and the change in momentum in each of the above cases			
2 HOURS	Newton's second law expressed in terms of momentum	• State Newton's second law in terms of momentum: *The net force acting on an object is equal to the rate of change of momentum* • Express Newton's second law in symbols: $F_{net} = \frac{\Delta p}{\Delta t}$ • Explain the relationship between net force and change in momentum for a variety of motions. • Calculate the change in momentum when a resultant force acts on an object and its velocity increases in the direction of motion (e.g.2nd stage rocket engine fires), decreases (e.g. brakes are applied), reverses its direction of motion e.g. a soccer ball kicked back in the direction it came from.			This is the general form of Newton's Second Law. The form $F_{net} = ma$ applies only to the special case when the mass is constant, and should be presented as such. Stress that the motion of an object, and therefore its momentum, only changes when a net (resultant) force is applied. Conversely, a net force causes an object's motion, and therefore its momentum, to change.

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
5 HOURS	Conservation of momentum and Elastic and Inelastic collisions.	• Explain what is meant by a system (in physics). • Explain (when working with systems) what is meant by internal and external forces. • Explain that an isolated system is one that has no net force (external) acting on it. • State the law of conservation of momentum as: *The total momentum of an isolated system remains constant* (is conserved). • Distinguish between elastic and inelastic collisions. • Know that kinetic energy is only conserved in an elastic collision. • Apply the conservation of momentum to collisions of two objects moving in one dimension (along a straight line) with the aid of an appropriate sign convention.	**<u>Prescribed Experiment for formal assessment</u>:** Conservation of linear momentum.	**Materials:** Air-track with blower. Two trolleys, pulley, two photo-gates, two retort stands, dual timer, metre-stick, black card, set of equal weights OR Two spring-loaded trolleys, stop-watch, meter-stick, two barriers	A system is a small part of the universe that we are considering when solving a particular problem. Everything outside this system is called the environment.
4 HOURS	Impulse	• Define impulse as the product of the net force and the contact time i.e. Impulse= $F_{net}\Delta t$ • Know that impulse is a vector quantity. • Know that $F_{net}\Delta t$ is a change in momentum, i.e. $F_{net}\Delta t = \Delta p$. This relationship is referred to as the impulse-momentum theorem • Use the impulse-momentum theorem to calculate the force exerted, time for which the force is applied and change in momentum for a variety of situations involving the motion of an object in one dimension • Apply the concept of impulse to safety considerations in everyday life, e.g. airbags, seatbelts and arrestor beds			A very important application of impulse is improving safety and reducing injuries. In many cases, an object needs to be brought to rest from a certain initial velocity. This means there is a certain specified change in momentum. If the time during which the momentum changes can be increased then the force that must be applied will be less and so it will cause less damage. This is the principle behind arrestor beds for trucks, airbags, and bending your knees when you jump off a chair and land on the ground.

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
5 HOURS	**<u>Vertical projectile motion in one dimension (1D)</u>**				
5 HOURS	Vertical projectile motion * (1D) represented in words, diagrams, equations and graphs * Near the surface of the Earth and in the absence of air friction	• Explain that projectiles fall freely with gravitational acceleration 'g' accelerate downwards with a constant acceleration irrespective of whether the projectile is moving upward or downward or is at maximum height. • Know that projectiles take the same time to reach their greatest height from the point of upward launch as the time they take to fall back to the point of launch. This is known as time symmetry. • Know that projectiles can have their motion described by a single set of equations for the upward and downward motion • Use equations of motion to determine the position, velocity and displacement of a projectile at any given time. • Draw position vs. time (x vs. t), velocity vs. time (v vs. t) and acceleration vs. time (a vs. t) graphs for 1D projectile motion. • Give equations for position versus time and velocity versus time for the graphs of 1D projectile motion. • Given x vs. t, v vs. t or a vs. t graphs determine position, displacement, velocity or acceleration at any time t. • Given x vs. t, v vs. t or a vs. t graphs describe the motion of the object e.g. graphs showing a ball, bouncing, thrown vertically upwards, thrown vertically downward, and so on.	**<u>Recommended experiment for informal assessment:</u>** Draw a graph of position vs. time and velocity vs. time for a free falling object. **AND** Use the data to determine the acceleration due to gravity.	**Materials:** Ticker tape apparatus, ticker-timer, mass, platform.	

GRADE 12 CHEMISTRY *(MATTER & MATERIALS)* TERM 1					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
12 HOURS	**<u>Organic molecules:</u>**	• Define organic molecules as molecules containing carbon atoms. • Describe carbon as the basic building block of organic compounds that recycles through the earth's air, water, soil, and living organisms.			NO mechanisms of reactions required ONLY reaction equations.
3 HOURS	Organic molecular structures – functional groups, saturated and unsaturated structures, isomers;	• Discuss the special properties of carbon that makes it possible to form a variety of bonds. • Give, condensed structural, structural and molecular formulae for alkanes and compounds containing the following functional groups: double carbon-carbon bonds, triple carbon-carbon bonds, alkyl halides, alcohols, carboxylic acids, esters, aldehydes, and ketones (up to 8 carbon atoms). • Explain the terms functional group, hydrocarbon and homologous series. • Explain the terms saturated, unsaturated and isomer • Identify compounds that are saturated, unsaturated and are isomers (up to 8 carbon atoms) • Isomers are restricted to structural isomers: (1) chain isomers (different chain); (2) positional isomers (different position of the same functional group) and (3) functional isomers (different functional group). Remember ALL possible isomers have the SAME molecular formula.	**<u>Recommended experiment for informal assessment</u>** (1) Alkanes and alkenes reactions with bromine water and potassium permanganate. (Indication of saturation and unsaturation) (2) Alkynes preparation and reactions with bromine water and potassium permanganate.(optional) **Experiments (optional)** (3) Comparing physical properties of the following compounds: propane, butane, pentane, ethanol, propan-1-ol and butan-1-ol. (Use for identifying physical properties: melting point, boiling point, vapour pressure.) (4) Searching for and presenting information on the principles and applications of the alcohol breathalyser.(optional application)	Visual aids that can be sourced: simulations and animations of organic molecules and organic reactions **Materials:**	A few core experiments are identified to illustrated specific concepts and the variety of further experiments are available if teachers want to use it. Links to Gr 11 multiple bonds Emphasis should be placed on different representations of organic compounds: macroscopic, sub-microscopic and symbolic representation and the links between them Also illustrate their 3D orientation using models to build them (marbles and prestik or jelly tots and toothpicks), Show reactions taking place with the models Explain the physical properties with the models Molecular formula = $C_5H_{12}O_1$ Structural formula = where ALL the bonds are shown. Condensed structural formula = where SOME of the bonds are shown $CH_3CH_2CH_2CH_2CH_2OH$.

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
3 HOURS	IUPAC naming and formulae,	• Give the IUPAC name when given the formula • Give the formula when given the IUPAC name • Naming is restricted to compounds with the functional groups alkanes, alkenes, alkynes, alkyl halides, aldehydes, ketones, alcohols, carboxylic acids and esters, up to a maximum of 8 carbon atoms in the parent chain (i.e. the longest chain). • Organic compounds are restricted to one type of functional group per compound and to a maximum of two functional groups of the same type per compound. • The only substituent chains that are allowed in naming and reactions are: methyl- and ethyl-groups • A maximum of THREE substituent chains (alkyl substituents) are allowed on the parent chain.	Practical investigation or experiment into the physical properties of organic molecules **Activity:** (1) Drawing structural formulae and writing systematic names for alkanes, alkenes, alcohols and carboxylic acids (2) Building molecular models of simple alkanes, alkenes, alcohols and carboxylic acids (use atomic model kits) (3) Building molecular models of compounds with different functional groups. (4) Building molecular models of but-2-enes (5) Building molecular models of butan-2-ol or propanoic acid		Link to Intermolecular forces in grade 11 Cycloalkanes, cycloalkenes and dienes are allowed under the same rules that apply to all the other organic molecules. Number longest chain beginning at the end nearest to the functional group with the alkyl substituents on the lowest numbered carbon atoms of the longest chain. Arrange substituents in alphabetical order in the name of the compound. Indicate the number of the carbon atom on which the substituent appears in the compound. Teach learners the meaning of primary, secondary and tertiary alcohols. For esters there can be 8 carbons in the alkyl group (from the alcohol) and 8 carbons in the carboxylic group (from the carboxylic acid). Both sides of the ester must be unbranched.
1 HOUR	Structure physical property relationships;	• Recognize and apply to particular examples (for compounds listed above) the relationship between: - physical properties and intermolecular forces - physical properties and number and type of functional groups - physical properties and chain length - physical properties and branched chains.			The physical properties to be considered are melting point, boiling point, and vapour pressure. The IMF to be considered are hydrogen bonds and Van der Waals forces.

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
1 HOUR	Applications of organic chemistry	• Alkanes are our most important (fossil) fuels. The combustion of alkanes (oxidation) is highly exothermic and carbon dioxide and water are produced: alkane + O_2 → H_2O + CO_2 with $\Delta H<0$ • An ester is a product of an acid catalyzed condensation between an alcohol and a carboxylic acid. • Identify the alcohol and carboxylic acid used to prepare a given ester and vice versa, and write an equation to present this preparation.	**<u>Prescribed experiment for formal assessment</u>** **(1)** Esters preparation and smell identification.	**Material:** Test tubes, water bowl, glass beaker, burner, test tube holder, propette, spatula, methanol, ethanol, pentanol, acetic acid, salicylic acid, concentrated sulphuric acid etc.	Use safety data to learn the properties of organic compounds.
3 HOURS	Substitution, addition and elimination. (ONLY alkanes, alkenes, alkynes, alcohols, halo-alkanes, carboxylic acids, and esters)	• **Addition reactions:** Unsaturated compounds (alkenes, cycloalkenes) undergo addition reactions: ○ Hydrohalogenation: Addition of HX to an alkene e.g. $CH_2 = CH_2 + HC\ell \rightarrow CH_3 - CH_2C\ell$ Reaction conditions: HX (X = Cℓ, Br, I) added to alkene; no water must be present (During addition of HX to unsaturated hydrocarbons, the H atom attaches to the C atom already having the greater number of H atoms. The X atom attaches to the more substituted C atom.) ○ Halogenation: Addition of X_2 (X = Cℓ, Br) to alkenes e.g. $CH_2 = CH_2 + C\ell_2 \rightarrow CH_2C\ell\text{-}CH_2C\ell$ Reaction conditions: X_2 (X = Cℓ, Br) added to alkene ○ Hydration: Addition of H_2O to alkenes e.g. $CH_2 = CH_2 + H_2O \rightarrow CH_3 - CH_2OH$ Reaction conditions: H_2O in excess and a small amount of HX or other strong acid (H_3PO_4) as catalyst (During addition of H_2O to unsaturated hydrocarbons, the H atom attaches to the C atom already having the greater number of H atoms. The OH group attaches to the more	**Experiment:** • Ethanol from ethene • Hydrogenation of vegetable oils to form margarine Unsaturated compounds undergo addition reactions to form saturated compounds e.g. $CH_2{=}CH_2 + C\ell_2 \rightarrow CH_2C\ell\text{-}CH_2C\ell$		Recall some organic compounds that are produced by people in their homes e.g. alcohol from sorghum beer or grapes or malt or rice. Why does over fermentation lead to acid formation? How is sour porridge made? What are the reactants and what are the products?

		substituted C-atom.) ○ Hydrogenation: Addition of H_2 to alkenes e.g. $CH_2 = CH_2 + H_2 \rightarrow CH_3 - CH_3$ Reaction conditions: alkene dissolved in a non polar solvent with the catalyst (Pt, Pd or Ni) in a H_2 atmosphere			
		• ***Elimination reactions:** Saturated compounds (haloalkanes, alcohols, alkanes) undergo elimination reactions ○ Dehydrohalogenation: Elimination of HX from a haloalkane e.g. $CH_2C\ell-CH_2C\ell \rightarrow CH_2 = CHC\ell + HC\ell$ Reaction conditions: heat under reflux (vapours condense and return to reaction vessel during heating) in a concentrated solution of NaOH or KOH in pure ethanol as the solvent i.e. hot ethanolic NaOH/KOH (If more than one elimination product is possible, the major product is the one where the H atom is removed from the C atom with the least number of H atoms) ○ Dehydration of alcohols: Elimination of H_2O from an alcohol e.g. $CH_3 - CH_2OH \rightarrow CH_2 = CH_2 + H_2O$ Reaction conditions: Acid catalyzed dehydration – heating of alcohol with an excess of concentrated H_2SO_4 (or H_3PO_4). (If more than one elimination product is possible, the major product is the one where the H atom is removed from the C atom with the least number of H atoms) ○ Cracking of hydrocarbons: Breaking up large hydrocarbon molecules into smaller and more useful bits. Reaction conditions: high pressures and temperatures without a catalyst (thermal cracking), or lower temperatures and pressures in	Saturated compounds undergo elimination reactions to form unsaturated compounds e.g. $CH_2C\ell-CH_2C\ell \rightarrow CH_2=CHC\ell + HC\ell$		

		the presence of a catalyst (catalytic cracking).			
		• ***Substitution reactions:** ○ Interconversion between alcohols and haloalkanes: Reactions of HX (X = Cℓ , Br) with alcohols to produce haloalkanes: Reaction conditions: - Tertiary alcohols are converted into haloalkanes using HBr or HCℓ at room temperature e.g. $C(CH_3)_3OH + HBr \rightarrow C(CH_3)_3Br + H_2O$ - Primary and secondary bromoalkanes: Treat primary and secondary alcohols with concentrated H_2SO_4 and solid NaBr (or KBr). The H_2SO_4 and solid NaBr reacts to form HBr: $H_2SO_4 + NaBr \rightarrow HBr + NaHSO_4$ The HBr reacts with the alcohol to form the bromoalkane: e.g. $CH_3CH_2OH + H_2SO_4 \rightarrow CH_3CH_2Br + NaHSO_4H_2O$ Reactions of bases with haloalkanes (hydrolysis) to produce alcohols e.g. $C(CH_3)_3X + KOH \rightarrow C(CH_3)_3OH + KBr$ Reaction conditions: Haloalkane dissolved in ethanol before treatment with aqueous sodium hydroxide and warming of the mixture; the same hydrolysis reaction occurs more slowly without alkali, i.e. H_2O added to the haloalkane dissolved in ethanol ○ Haloalkanes from alkanes. Reaction conditions: X_2 (X = Br, Cℓ) added to alkane in the presence of light or heat	Two types of saturated structure can be inter-converted by substitution e.g. • $C(CH_3)_3OH + HBr \rightarrow C(CH_3)_3Br + H_2O$ • $C(CH_3)_3Br + KOH \rightarrow C(CH_3)_3OH + KBr$ • Write equations for simple substitution reactions e.g. Organic reactions: • $CH_4 + C\ell_2 \rightarrow CH_3C\ell + HC\ell$ • $CH_3C\ell + H_2O \rightarrow CH_3OH + HC\ell$		
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
1 HOUR	Substitution, addition and elimination. (ONLY alkanes,	• Describe criteria to use to **classify** elimination, substitution or addition reactions according to structural change • **Identify a reaction** as an example of an	**Experiment:** (1) Alkanes and alkenes react with bromine and potassium permanganate (substitution and	**Matertials:** Propettes, test tubes, solid stoppers, spatula, hexane, hexene,	Link to reactions used in industry: Substitution, addition and elimination.

	alkenes, alkynes, alcohols, halo-alkanes, carboxylic acids, and esters)	elimination, substitution or addition reaction from a list of example reaction equations • List and describe **elimination reactions** that are important in industry i.e. in polymer industry. (ONE REACTION) • Describe **addition reactions** that are important in industry e.g. addition polymerization reactions to produce polyethylene, polypropylene, and PVC. (ONE REACTION)	addition) Only the reaction of alkenes with **potassium permanganate** in *alkaline solution* should be added as an activity. This will result in the formation of the diol and would be an addition reaction	bromine water, spatula, potassium permanganate, dilute hydrochloric acid, chloroform.	SASOL – polymers Include ONLY these three reaction types, and not further specifying reactions

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
4 HOURS	**<u>Organic macromolecules:</u>**				
4 HOURS	Plastics and polymers **(**ONLY BASIC POLYMERISATION as application for organic chemistry)	• Describe the term polymer; macromolecule, chain, monomer, heterogeneous mixture, functional groups. • Illustrate the reactions to produce polymers by <u>addition reaction</u> using the free radical polymerization of ONLY ethene to produce polythene. • Explain the terms initiation, propagation and termination. • Illustrate the reactions to produce polymers by <u>condensation reaction</u> with the reactions to produce NYLON and polyester. • Identify the monomer used to produce a polymer from the structural formula of a section of a chain. • Identify a polymer as the product of an addition or condensation polymerization reaction, from its structural formula.	**Experiment** (1) Plastics physical properties and recycling numbers (2) Performing an experiment to prepare an addition polymer. **Activities:** (1) Searching for information or reading articles about the discovery of polyethene and the development of addition polymers. (2) Building physical or computer models of addition polymers. (3) Searching for and presenting information on environmental issues related to the use of plastics (4) Conducting a survey to investigate the quantities and types of solid waste generated at home or school and suggesting methods to reduce these wastes. **Experiments** (1) Polymerization – silicone rubber from sodium silicate and ethyl alcohol. (2) Polymerization – polymeric sulphur i.e. plastic sulphur. **<u>Recommended experiment for informal assessment</u>** (3) Cross-linking polymers – polyvinyl alcohol and sodium borate to make	**Materials:** PVA and sodium borate White wood glue (Alcolin, or Red Devil) and Borax powder, food colouring, empty yogurt containers, glass	Make learners aware of new materials made from polymers. What are Kevlar and Mylar? What are the functions of these materials and what are they used for? Who discovered or invented the materials? What are windscreens made off? What are break pads made off? Discuss the different polymers that are used instead of glass. .

			"slime" (4) Cross-linking polymers – white wood glue and borax to make "silly putty"	beaker, stirring rod.	

ASSESSMENT TERM 1	**<u>TERM 1:Recommended Formal Assessment</u>** **[1] Experiment (Chemistry): Preparation of esters**

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GRADE 12 PHYSICS *(MECHANICS)* TERM 2					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
10 HOURS	**Work, Energy & Power**				
2 HOURS	Definition of Work	• Define the work done on an object by a force as : $W=F\Delta x\cos\theta$. • Know that work is a scalar quantity and is measured in joules (J). • Calculate the net work done on an object by applying the definition of work to each force acting on the object while it is being displaced, and then adding up (scalar) each contribution. • Positive net work done on a system will increase the energy of the system and negative net work done on the system will decrease the energy of the system. **ALTERNATE METHOD FOR DETERMINING THE NET WORK.** 1. Draw a force diagram showing only forces that act along the plane. Ignore perpendicular forces. 2. Calculate the resultant force (along the plane). 3. Calculate the net work done on an object by taking the product of the resultant force (along the plane) acting on the object and its displacement along the plane.			Stress the difference between the everyday use of the word "work" and the physics use. Only the component of the applied force that is parallel to the motion does work on an object. So, for example, a person holding up a heavy book does no work on the book. Forces ⊥ to the objects displacement do no work on the object, since $\theta=90^o$ ($\cos\theta=0$) Forces parallel to the objects displacement do positive work on the object, since $\theta=0^o$ ($\cos\theta=1$) Forces anti-parallel to the objects displacement (eg friction) do negative work on the object, since $\theta=180^o$ ($\cos\theta=-1$)

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
2 HOURS	Work –Energy Theorem	• Know that the net work done on an object causes a change in the object's kinetic energy – the *work-energy theorem* – $W_{net} = E_{kf} - E_{ki}$ • Apply the work-energy theorem to objects on horizontal and inclined planes (frictionless and rough).			NOTE: a force only does work on an object if it stays in contact with the object. For example, a person pushing a trolley does work on the trolley, but the road does no work on the tyres of a car if they turn without slipping (the force is not applied over any distance because a different piece of tyre touches the road every instant).
3 HOURS	Conservation of energy with non-conservative forces present.	• Define conservative forces and give an example. • Define non-conservative forces and give examples. • Know that when only conservative forces are present, mechanical energy is conserved. • Know that when non-conservative forces are present mechanical energy (sum of kinetic and potential) is not conserved, but total energy (of the system) is still conserved. • Solve conservation of energy problems (with dissipative forces present) using the equation: $W_{nc} = \Delta E_k + \Delta E_p$ • Use the above relationship to show that in the absence of non-conservative forces, mechanical energy is conserved.			A force is a conservative force if the net work done the force in moving an abject around a closed path, starting and ending at the same point is zero. Gravitational force is an example of a conservative force. Examples of non-conservative forces include air resistance, friction, tension and applied forces. W_{nc} represents the work done by the non-conservative forces

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
3 HOURS	Power	• Define power as the rate at which work is done. • Calculate the power involved when work is done • If a force causes an object to move at a constant velocity, calculate the power using P=Fv. • Calculate the minimum power required of an electric motor to pump water from a borehole of a particular depth at a particular rate using $W_{nc} = \Delta E_k + \Delta E_p$ • Calculate the power of different kinds of cars operating under different conditions.	**Recommended practical investigation for informal assessment:** Perform simple experiments to determine the work done in walking up (or running up a flight of stairs). By timing the run and walk (same flight of stairs) one can enrich the concept of power.	**Materials:** Flight of stairs, stopwatch, measuring tape (5m) or meter stick,	

GRADE 12 PHYSICS *(WAVES, SOUND & LIGHT)* TERM 2					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
6 HOURS	**<u>Doppler Effect (relative motion between source observer)</u>**				
4 HOURS	With sound and ultrasound	• State the Doppler Effect for sound and give everyday examples. • Explain (using appropriate illustrations) why a sound increases in pitch when the source of the sound travels towards a listener and decreases in pitch when it travels away • Use the equation $f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ to calculate the frequency of sound detected by a listener (L) when either the source or the listener is moving. • Describe applications of the Doppler Effect with ultrasound waves in medicine, e.g. to measure the rate of blood flow or the heartbeat of a foetus in the womb.	**Practical Demonstration:** Doppler effect	**Materials:** Tuning fork (or small sound source), string	Doppler applications would involve either a moving source (stationary observer) or a moving observer (stationary source)
2 HOURS	With light – red shifts in the universe (evidence for the expanding universe).	• State that light emitted from many stars is shifted toward the red, or longer wavelength/lower frequency, end of the spectrum due to movement of the source of light. • Apply the Doppler Effect to these "red shifts" to conclude that most stars are moving away from Earth and therefore the universe is expanding.			No calculations are to be done on red shifts. Electromagnetic Spectrum - the red end of the spectrum corresponds to lower frequency and the blue end to higher frequency light. Matter and Materials - emission spectra and discuss the fact that stars emit light of frequencies that are determined by their composition.

GRADE 12 CHEMISTRY *(CHEMICAL CHANGE)* TERM 2					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
4 HOURS	**<u>Rate and Extent of Reaction:</u>**				
2 HOURS	Rates of reaction and factors affecting rate (nature of reacting substances, concentration [pressure for gases], temperature and presence of a catalyst);	• Explain what is meant by reaction rate • List the factors which affect the rate of chemical reactions. (Surface area (solid), concentration (solution), pressure (gas), temperature, and catalyst.) • Explain in terms of collision theory how the various factors affect the rate of chemical reactions.	**Experiments:** (1) Effect of concentration – vinegar and baking soda (2) Effect of temperature – vinegar and baking soda; Alka Seltzer or Cal-C-Vita (3) Effect of temperature and concentration – potassium iodate (0.01 M), soluble starch, NaS_2O_3 and H_2SO_4 (iodine clock reaction) (4) Effect of catalyst – hydrogen peroxide and manganese dioxide; burning a sugar cube with and without dipping in activated carbon. Also adding a piece of copper to the reaction between zinc and HCl will accelerate the rate.	**Materials:**	This section must be done very well; deep understanding of this section gives the foundation for incisive knowledge later. Link chemical systems grade 12 to industrial processes. Very useful PHET simulations of reaction rate are available. Also others like Greenbowe simulations for redox reactions
1 HOUR	Measuring rates of reaction;	• Suggest suitable experimental techniques for measuring the rate of a given reaction including the measuring of gas volumes, turbidity (e.g. precipitate formation), change of colour and the change of the mass of the reaction vessel.	Turbidity is seldom quantitatively accurate, but it is useful. **Experiment** (1) Reaction rate and the influence of all the rate factors in the reaction of Zn and HCl. **<u>Recommended experiment for informal assessment</u>** (2) Quantitative reaction rate and drawing graphs in the reaction between $Na_2S_2O_3$ and HCl.	**Materials:** Sodium sulphite, dilute hydrochloric acid, 5 test tubes, glass beaker, propette, 2,5 ml syringe, white paper, pencil, stop watch or cell phone with stop watch function, ice, burner, spatula, graph paper.	This is an important section for illustrating and assessing understanding of investigative process, the relationship between theory and experiment, the importance of empirical data and mathematical modelling of relationships. Teaching about practical investigations should form part of this section

1 HOUR	Mechanism of reaction and of catalysis;	• Define activation energy – the minimum energy required for a reaction to take place. Colliding molecules must have, apart from the correct orientation, a kinetic energy equal to or bigger than the activation energy of a reaction before the reaction can take place. • Use a graph showing the distribution of molecular energies (number of particles against their kinetic energy) to explain why only some molecules have enough energy to react and hence how adding a catalyst and heating the reactants affects the rate. • Explain (in simple terms) how some catalysts function by reacting with the reactants in such a way that the reaction follows an alternative path of lower activation energy.	**Activity:** (1) Using appropriate methods, skills, and techniques, such as the micro-scale chemistry technique to study the progress of a reaction.	**Materials:**	Activation energy revised. This topic is very important and relevant for realistic understanding.
TIME	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
8 HOURS	**<u>Chemical Equilibrium</u>**				
2 HOURS	Chemical equilibrium and factors affecting equilibrium;	• Explain what is meant by: – Open and closed systems – A reversible reaction – Dynamic equilibrium • List the factors which influence the **position** of an equilibrium	**<u>Recommended experiment for informal assessment</u>** (1) Equilibrium and the factors influencing equilibrium on the equilibrium of $CoCl_2$ and H_2O (2) Designing and performing an experiment to investigate effects of pH on equilibrium systems such as: $Br_2(aq) + H_2O(l) \rightleftarrows HOBr(aq) + H^+(aq) + Br^-(aq)$ $Cr_2O_7^{2-}(aq) + H_2O(l) \rightleftarrows 2CrO_4^{2-}(aq) + 2H^+(aq)$	**Material** 5 test tubes, cobalt chloride, ethanol, silver nitrate, sodium chloride, dilute hydrochloric acid, water, ice, glass beaker, spatula, burner.	Use liquid vapour equilibrium in a closed system to illustrate reversibility.
4 HOURS	Equilibrium constant;	• List the factors which influence the **value** of the equilibrium constant K_c • Write down an expression for the	**Activity:** (1) Search for information on issues related to chemical		

		equilibrium constant having been given the equation for the reaction. • Perform calculations based on K_c values. • Explain the significance of high and low values of the equilibrium constant.	equilibrium. (2) Investigating examples of reversible and irreversible reactions. (3) Investigating the effect of changes in concentration or temperature on chemical equilibria using a computer simulation.		
2 HOURS	Application of equilibrium principles.	• State Le Chatelier's principle. Use Le Chatelier's principle to identify and explain the effects of changes of pressure, temperature, and concentration (common ion effect) on the concentrations and amounts of each substance in an equilibrium mixture. Explain the use of a catalyst and its influence on an equilibrium mixture. • Interpret graphs of equilibrium. • Apply the rate and equilibrium principles to important industrial applications e.g. Haber process.			**Definition:** Le Chatelier's principle states that a change in any of the factors that determine equilibrium conditions of a system will cause the system to change in such a manner as to reduce or counteract the effect of the change.
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
8 HOURS	**<u>Acids and Bases</u>**				
8 HOURS	Acid-base reactions	• Explain what is meant by acids and bases? • State acid and base models (Arrhenius, Lowry-Brønsted) • Write the reaction equations of aqueous solutions of acids and bases • Give conjugate acid-base pairs for given compounds. • Determine the approximate pH of salts in salt hydrolysis. • Give the neutralisation reactions of common laboratory acids and bases. • How do indicators work? What is the range of methyl orange, bromo thymol blue and phenolphthalein indicators?	**Activities and experiments** (1) Search for examples of naturally occurring acids and bases, and their chemical composition. (2) Investigating the actions of dilute acids on metals, metal carbonates, metal hydrogen carbonates, metal oxides and metal hydroxides.(revision of grade 11) (3) Searching for information about hazardous nature of acids and bases. (4) Investigating the action of dilute bases on aqueous	There are useful animations of titrations available to use here (e.g. Greenbowe animations)	Acids and bases are introduced in Grade 11 and done in more detail here, including calculations

		• Do simple acid-base titrations • Do calculations based on titration reactions • Name some common strong and weak acids and bases. • Explain the pH scale. • Calculate pH values of strong acids and strong bases. • Define the concept of $K_{w.}$ • Distinguish between strong and concentrated acids. • Distinguish between concentrated and dilute acids. • Explain the auto-ionisation of water • Compare the K_a and K_b values of strong and weak acids and bases. • Compare strong and weak acids by looking at (1) pH (2) conductivity (3) reaction rate • Look at the application of acids and bases in the Chlor-alkali industry (chemical reactions only) • Look at the application of acids and bases in the chemistry of hair. (What is the pH of hair? What is permanent waveing lotion and how does it work? What are hair relaxers and how do they work? Discuss different ways of colouring hair.)	metal ions to form metal hydroxide precipitates. (5) Performing experiments to investigate the corrosive nature of concentrated acids and bases (drain cleaners, battery acid, swimming pool acid etc.) (6) Investigate the temperature change in a neutralisation process. **<u>Prescribed experiment for formal assessment</u>** (7) Preparing a standard solution for volumetric analysis. (8) Performing acid-base titrations using suitable indicators e.g. oxalic acid against sodium hydroxide with phenolphthalein as indicator. (9) Using a titration experiment to determine the concentration of acetic acid in vinegar or the concentration of sodium hydroxide in drain cleaner. (10) Do acid-base titration experiments to determine presence of acid in a compound (% of ethanoic acid in vinegar etc.)	**Material** 25 ml volumetric flask, mass meter, spatula, oxalic acid, water, watch glass, burette (or two Swift pipettes), test tubes, sodium hydroxide, glass beaker, apparatus stand, phenolphthalein as indicator, funnel.	pH meters and data loggers can also be used in titrations if they are available. <u>Hair straightening</u> Hair straightening compounds have high pH, sometimes 13. This is usually a strong base, NaOH. If not used properly, it may hurt or burn the scalp. (Look at "The truth about hair relaxers" on the internet.)
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**

ASSESSMENT TERM 2	**TERM 2:Recommended Formal Assessment** **[1] Experiment (Chemistry):** How do you use the titration of oxalic acid against sodium hydroxide to determine the concentration of the sodium hydroxide? **OR** **Experiment (Physics):** Conservation of linear momentum. (This experiment should must be conducted when teaching the section on momentum but formally assessed in term2) **[2] Midyear Examinations**

GRADE 12 PHYSICS *(ELECTRICITY & MAGNETISM)* TERM 3					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
4 HOURS	**<u>Electric circuits</u>**				
4 HOURS	Internal resistance and series- and parallel networks	• Solve problems involving current, voltage and resistance for circuits containing arrangements of resistors in series and in parallel. • State that a real battery has internal resistance • The sum of the voltages across the external circuit plus the voltage across the internal resistance is equal to the emf: $\varepsilon = V_{load} + V_{internal\ resistance}$ or $\varepsilon = IR_{ext} + Ir$ • Solve circuit problems in which the internal resistance of the battery must be considered. • Solve circuit problems, with internal resistance, involving series-parallel networks of resistors	**<u>Prescribed experiment for formal assessment</u>:** (part 1 and part 2) **Part 1** Determine the internal resistance of a battery. **Part 2** Set up a series parallel network with known resistor. Determine the equivalent resistance using an ammeter and a voltmeter and compare with the theoretical value. **<u>Recommended Practical Investigation for informal assessment:</u>** Set up a series parallel network with an ammeter in each branch and external circuit and voltmeters across each resistor, branch and battery, position switches in each branch and external circuit. Use this circuit to investigate short circuits and open circuits.	**Materials:** Battery, connecting wires resistor, voltmeter, ammeter and switch. **Materials:** Battery, connecting wires, several resistors of different values, voltmeter, ammeter and switch. **Materials:** Battery, connecting wires, several resistors of different values, several voltmeters, several ammeter, switches, a length of low resistance wire.	Some books use the term "lost volts" to refer to the difference between the emf and the terminal voltage. This is misleading. The voltage is not "lost", it is across the internal resistance of the battery. The internal resistance of the battery can be treated just like another resistor in series in the circuit. The sum of the voltages across the external circuit plus the voltage across the internal resistance is equal to the emf: $\varepsilon = V_{load} + V_{internal\ resistance}$

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
8 HOURS	**Electrodynamics**				
4 HOURS	Electrical machines (generators, motors)	• State that generators convert mechanical energy to electrical energy and motors convert electrical energy to mechanical energy • Use Faraday's Law to explain why a current is induced in a coil that is rotated in a magnetic field. • Use words and pictures to explain the basic principle of an AC generator (alternator) in which a coil is mechanically rotated in a magnetic field • Use words and pictures to explain how a DC generator works and how it differs from an AC generator. • Explain why a current-carrying coil placed in a magnetic field (but not parallel to the field) will turn by referring to the force exerted on moving charges by a magnetic field and the torque on the coil • Use words and pictures to explain the basic principle of an electric motor. • Give examples of the use of AC and DC generators. • Give examples of the use of motors.	**Project:** Build a simple electric generator. **Project:** Build a simple electric motor.	**Materials:** Enamel coated copper wire, 4 large ceramic block magnets, cardboard (packaging), large nail, 1.5 V 25mA light bulb. **Materials:** 2 pieces of thin aluminium strips 3cmx6cm, 1.5 m of enamel coated copper wire, 2 lengths of copper wire, a ring magnet (from an old speaker) a 6cmx15cm block of wood, sandpaper and thumb tacks.	The basic principles of operation for a motor and a generator are the same, except that a motor converts electrical energy into mechanical energy and a generator converts mechanical energy into electrical energy. Both motors and generators can be explained in terms of a coil that rotates in a magnetic field. In a generator the coil is attached to an external circuit and mechanically turned, resulting in a changing flux that induces an emf. In an AC generator the two ends of the coil are attached to a slip ring that makes contact with brushes as it turns. The direction of the current changes with every half turn of the coil. A DC generator is constructed the same way as an AC generator except that the slip ring is split into two pieces, called a commutator, so the current in the external circuit does not change direction. In a motor, a current-carrying coil in a magnetic field experiences a force on both sides of the coil, creating a torque, which makes it turn. **A note on torque:** Know that the moment of a force, or torque, is the product of the distance from the support (pivot point) and the

					component of the force perpendicular to the object.
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
4 HOURS	Alternating current	• Explain the advantages of alternating current • Write expressions for the current and voltage in an AC circuit • Define the rms (root mean square) values for current and voltage as $I_{rms} = \frac{I_{\max}}{\sqrt{2}}$ and $V_{rms} = \frac{V_{\max}}{\sqrt{2}}$ respectively, and explain why these values are useful. • Know that the average power is given by: $P_{av} = I_{rms}V_{rms} = \frac{1}{2}I_{\max}V_{\max}$ (for a purely resistive circuit) • Draw a graph of voltage vs time and current vs time for an AC circuit. • Solve problems using the concepts of I_{rms}, V_{rms}, P_{av}			The main advantage to AC is that the voltage can be changed using transformers (device used to increase or decrease the amplitude of an AC input). That means that the voltage can be stepped up at power stations to a very high voltage so that electrical energy can be transmitted along power lines at low current and therefore experience low energy loss due to heating. The voltage can then be stepped down for use in buildings, street lights, and so forth.

GRADE 12 PHYSICS *(MATTER & MATERIALS)* TERM 3					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
6 HOURS	**<u>Optical phenomena and properties of materials</u>**				
4 HOURS	Photoelectric effect	• Describe the photoelectric effect as the process that occurs when light shines on a metal and it ejects electrons. • Give the significance of the photo-electric effect: it establishes the quantum theory and it illustrates the particle nature of light • Define cut-off frequency, f_o • Define work function and know that the work function is material specific • Know that the cut-off frequency corresponds to a maximum wavelength • Apply the photo-electric equation: $E = W_o + KE_{max}$, where $E = hf$ and $W_o = hf_o$ $KE_{max} = \frac{1}{2}m(v_{max})^2$ • Know that the number of electrons ejected per second increases with the intensity of the incident radiation • Know that if the frequency of the incident radiation is below the cut-off frequency, then increasing the intensity of the radiation has no effect i.e. it does not cause electrons to be ejected.	**Practical Demonstration:** Photoelectric effect	**Materials:** Mercury discharge lamp; photosensitive vacuum tube; set of light filters; circuit to produce retarding voltage across phototube; oscilloscope, ammeter.	
2 HOURS	Emission and absorption spectra	• Explain the source of atomic emission spectra (of discharge tubes) and their unique relationship to each element • Relate the lines on the atomic spectrum to electron transitions between energy levels • Explain the difference between of atomic absorption and emission spectra			Application to astronomy.

GRADE 12 CHEMISTRY *(CHEMICAL CHANGE)* TERM 3					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**

8 HOURS	**<u>Electrochemical reactions:</u>**				
2 HOURS	Electrolytic cells and galvanic cells;	• Define the galvanic cell in terms of: self-sustaining electrode reactions conversion of chemical energy to electrical energy • Define the electrolytic cell in terms of: electrode reactions that are sustained by a supply of electrical energy conversion of electrical energy into chemical energy. • Define oxidation and reduction in terms of electron (e^-) transfer. • Define oxidising agent and reducing agent in terms of oxidation and reduction. • Define anode and cathode in terms of oxidation and reduction.	**<u>Recommended experiment for informal assessment</u>** (1) Electrolysis of water and sodium iodide. **<u>Recommended experiment for informal assessment</u>** (2) Find the Galvanic cell with the highest potential. (3) Reduction of metal ions and halogens.	**Materials:** Water bowl, electrodes for the electrolysis of water, test tubes, conductivity wires, 9 volt battery, current indicator (LED), water and sodium iodide and sodium sulphate. **Materials:** Zinc, lead, aluminium and copper electrodes, zinc sulphate, copper sulphate, lead nitrate, sodium hydroxide, and potassium nitrate.	RECAP the redox reactions studied in grade 11. Link to: Grade 11 Oxidation number and Grade 11 Redox reactions. USE SINGLE ARROWS in redox chemical equations and half reactions, but KNOW that all chemical reactions are by nature reversible (equilibrium reactions).
1 HOUR	Relation of current and potential to rate and equilibrium;	• Give and explain the relationship between current in an electrochemical cell and the rate of the reaction • State that the potential difference of the cell (V_{cell}) is related to the extent to which the spontaneous cell reaction has reached equilibrium • State and use the qualitative relationship between V_{cell} and the concentration of product ions and reactant ions for the spontaneous reaction viz. V_{cell} decreases as the concentration of product ions increase and the concentration of reactant ions decrease until equilibrium is reached at which the $V_{cell} = 0$ (the cell is 'flat'). (Qualitative treatment only. Nernst			Illustrate processes sub-microscopically. Le Chatelier's principle can be used to argue the shift in equilibrium.

		equation is NOT required)			

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
2 HOURS	Understanding of the processes and redox reactions taking place in cells;	• Describe the movement ions through the solutions the electron flow in the external circuit of the cell the half reactions at the electrodes the function of the salt bridge in galvanic cells • Use cell notation or diagrams to represent a galvanic cell.			
	Standard electrode potentials;	• Give the standard conditions under which standard electrode potentials are determined • Describe the standard hydrogen electrode and explain its role as the reference electrode • Explain how standard electrode potentials can be determined using the reference electrode and state the convention regarding positive and negative values. • Use the Table of Standard Reduction Potentials to calculate the emf of a standard galvanic cell. • Use a positive value of the standard emf as an indication that the reaction is spontaneous under standard conditions			**Cell notations** can be used to represent galvanic cells. e.g. for the zinc – copper cell the following notation can be used: Zn/Zn^{2+} // Cu^{2+} / Cu at concentrations of 1 mol/dm^3. Oxidation at the anode on the left separated by the salt bridge (//) with reduction at the cathode on the right.
2 HOURS	Writing of equations representing oxidation and reduction half reactions and redox reactions	• Predict the half-cell in which oxidation will take place when connected to another half-cell. • Predict the half-cell in which reduction will take place when connected to another half-cell. • Write equations for reactions taking place at the anode and cathode. • Deduce the overall cell reaction by combining two half-reactions • Describe, using half equations and the equation for the overall cell reaction, the following electrolytic processes			Link to: Oxidation numbers in grade 11. USE SINGLE ARROWS in redox chemical equations and half reactions, but KNOW that all chemical reactions are by nature reversible (equilibrium reactions).

		The decomposition of copper chloride A simple example of electroplating (e.g. the refining of copper)			

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource Material	Guidelines for Teachers
1 HOUR	Oxidation numbers and application of oxidation numbers	• Revise from grade 11 and extend in grade 12 • Describe, using half equations and the equation for the overall cell reaction, the layout of the particular cell using a schematic diagram and potential risks to the environment of the following electrolytic processes used industrially: (i) The production of chlorine (chemical systems: the chloroalkali-industry). (ii) The recovery of aluminium metal from bauxite. (South Africa uses bauxite from Australia.)	The applications should provide real life examples of where electrochemistry is used in industry. The industry per se need not to be studied, but assessment should be done using the chemical reactions that is used in industry		

GRADE 12 CHEMISTRY *(CHEMICAL SYSTEMS)* TERM 3					
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource Material**	**Guidelines for Teachers**
	CHOOSE one TOPIC under Chemical Systems or do ONE topic each week for THREE or FOUR weeks				
6 HOURS	**<u>Chemical industry – resources, needs and the chemical connection:</u>**	• Basic knowledge about the industry • Products of the industry and their application to our daily lives (e.g. car batteries and rechargeable batteries, soaps and detergents, fertilizers, petrol and plastics) • Importance of the industry in South Africa • Impact of the industry on the environment • Identify some reactions that links up with other topics taught in grade 12 to provide context for them			KEEP THE DETAIL IN THIS SECTION LIMITED TO APPLICATION
	<u>Chemical industry</u>				
6 HOURS	The fertilizer industry (N, P, K).	• List, for plants, (a) three non-mineral nutrients, i.e. nutrients that are not obtained from the soil: C, H and O and their sources i.e. the atmosphere (CO_2) and rain (H_2O) (b) three primary nutrients N, P and K and their source i.e. the soil. (c) These nutrients are mineral nutrients that dissolve in water in the soil and are absorbed by the roots of plants. Fertilizers are needed because there are not always enough of these nutrients in the soil for healthy growth of plants. • Explain the function of N, P and K in plants • Give the source of N (guano), P (bone meal) and K (German mines) before and after the first world war) • Interpret the N:P:K fertilizer ratio • Describe and explain (rates, yields, neutralization, …), using chemical equations where ever appropriate, these aspects of the industrial manufacture of fertilizers, given	**Activity:** **Stoichiometry** of production of N, P, K in industry. • The quality of water sources in the country has been on the news a lot in our country. Rivers used to be clean sources of water, do an investigation on the causes of this high pollution of rivers near you. • Assess how many people rely on fertilizers for their gardens in your area, assess whether the use of inorganic fertilizers has gone up. Research if this can be related to the quality of water in the river near your village, town, city. • Discuss advantages of inorganic fertilizers • Discuss alternatives to inorganic fertilizers (IKS) • Discuss how the public can help to prevent eutrophication.		Link to Gr 11:Lithosphere – mining and mineral processing (especially phosphates and potassium salts) Acid and base reactions – especially neutralisation Gr 12 rate and extent of reactions Chemical systems SASOL the manufacture of fertilizers

		diagrams, flow charts and so on N_2 – fractional distillation of air H_2 – at SASOL from coal and steam NH_3 – Haber process; HNO_3 – the Ostwald process; H_2SO_4 – including the contact process; H_3PO_4; Ca $(H_2PO_4)_2$ (super phosphates) NH_4NO_3; $(NH_4)_2SO_4$; H_2NCONH_2 (urea); • Give sources of potash (mined imported potassium salts like KNO_3, K_2SO_4, KNO_3,) • Evaluate the use of inorganic fertilizers on humans and the environment. • Link SASOL to the production of fertilizers i.e. ammonium nitrate (fertilizer and explosive) • Define Eutrophication • Discuss alternatives to inorganic fertilizers as used by communities.			Knowledge of eutrophication is expected.
Time	**Topics Grade 12**	**Content, Concepts & Skills**	**Practical Activities**	**Resource material**	**Guidelines for Teachers**

ASSESSMENT TERM 3	**<u>TERM 3:Recommended Formal Assessment</u>** **[1] Experiment (Physics): Determine internal resistance of a battery.** **[2] Trial Examination**

GRADE 12 PHYSICS

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource material	Guidelines for Teachers
2 HOURS	Mechanics, Electricity and Magnetism, Waves, Sound and Light	• Consolidate the laws and principles covered in the grade 11syllabus viz. 1. Newton's Laws and Application of Newton's Laws 2. Electrostatics (Coulomb's Law and Electric field) 3. Electric circuits (Ohm's Law, Power and Energy) • Do further integrated problem solving activities.			Problem-solving activities integrating any of: energy, momentum, electrostatics and/or mechanics.
2 HOURS	Mechanics, Electricity and Magnetism, Waves, Sound and Light	• General revision and consolidation. • Examination tips for example utilization of time, numbering of answers to questions in the exam paper, etc. • Revision of problem solving strategies using relevant problem solving activities.			

GRADE 12 CHEMISTRY

Time	Topics Grade 12	Content, Concepts & Skills	Practical Activities	Resource material	Guidelines for Teachers
2 HOURS	Organic chemistry	• Consolidate the use of IUPAC names, functional groups, organic reactions, isomers, monomers and polymers, addition and condensation reactions of polymers. • Do further integrated problem solving activities.			

1 HOUR	Rate and Equilibrium	• Revise the factors that influence rate and equilibrium; how to measure rate; how to calculate the equilibrium constant and use the value of K in calculations; effect of Le Chatelier's principle.			
1 HOUR	Acids & Bases and Electrochemistry	• General revision and consolidation. • Examination tips for example utilization of time, numbering of answers to questions in the exam paper, etc. • Revision of problem solving strategies using relevant problem solving activities.			

ASSESSMENT TERM 4	**<u>TERM 4:Recommended Formal Assessment</u>** **[1] Final Examinations**