SUBJECT and GRADE	Physical Sciences, Grade 12	
TERM 2	*Week 7*	
TOPIC	Acids & Bases	
AIMS OF LESSON	**Acids and Bases** – The learner should be able to apply scientific and investigative skills to solve problems on the following aspects of Acids & Bases: o Reactions o Titrations o pH o Salt hydrolysis	
RESOURCES	***Paper based resources***	***Digital resources***
	Acid-Base Notes: **Mind the Gap text books p 122 – 154.** **Other school text book you have.** **Link (PDF):** https://drive.google.com/file/d/1qwM6kDuLqsY4oLQ21L-BMc0JRER84ALV/view?usp=sharing **Link (Power point):** https://drive.google.com/open?id=1ju88rgQWM_Pvi9OmTv8AIah2viAaZnun **Past NSC Examination papers (Paper 2, question 7)**	**Siyavula Text Book:** **Link:** https://www.siyavula.com/read/science/grade-12/acids-and-bases/09-acids-and-bases-01 **Science Clinic, p. 55-57:** **Link**: https://drive.google.com/file/d/1McK-bKUrUujmtiBD4qRXtDpRgeoOXABX/view?usp=sharing **Mind the Gap, p. 122-154:** **Link: https://bit.ly/2zaxUxk**

INTRODUCTION	Revision of the following content from grades 10 & 11 is necessary to master the content on Acids & Bases. **Grade 10:** **Physical and chemical change** (conservation of atoms and mass; law of constant composition). Representing chemical change (balanced chemical equations). Reactions in aqueous solution (ions in aqueous solutions; ion interaction; precipitation; chemical reaction types) Stoichiometry (mole concept). **Grade 11:** **Stoichiometry** (molar volume of gases; concentration; limiting reagents; volume relationships in gaseous reactions).
CONCEPTS AND SKILLS	**NOTE: DOWNLOAD THE NOTES (PDF or POWER POINT) BY CLICKING THE LINK UNDER PAPER BASED RESOURCES ABOVE FOR DETAIL ON THE FOLLOWING CONTENT.** **Acid-base reactions** • Define *acids* and *bases* according to Arrhenius and Lowry-Brønsted: Arrhenius theory: An acid is a substance that produces hydrogen ions (H^+)/hydronium ions (H_3O^+) when it dissolves in water. A base is a substance that produces hydroxide ions (OH^-) when it dissolves in water. Lowry-Brønsted theory: An acid is a proton (H^+ ion) donor. A base is a proton (H^+ ion) acceptor. • Distinguish between *strong acids/bases* and *weak acids/bases* with examples. Strong acids ionise completely in water to form a high concentration of H_3O^+ ions. Examples of strong acids are hydrochloric acid, sulphuric acid and nitric acid. Weak acids ionise incompletely in water to form a low concentration of H_3O^+ ions. Examples of weak acids are ethanoic acid and oxalic acid. Strong bases dissociate completely in water to form a high concentration of OH^- ions. Examples of strong bases are sodium hydroxide and potassium hydroxide. Weak bases dissociate/ionise incompletely in water to form a low concentration of OH^- ions. Examples of weak bases are ammonia, calcium carbonate, potassium carbonate, calcium carbonate and sodium hydrogen carbonate. •Distinguish between *concentrated acids/bases* and *dilute acids/bases*. Concentrated acids/bases contain a large amount (number of moles) of acid/base in proportion to the volume of water. Dilute

	acids/bases contain a small amount (number of moles) of acid/base in proportion to the volume of water. •Write down the reaction equations of aqueous solutions of acids and bases. Examples: $HC\ell(g) + H_2O(\ell) \rightarrow H_3O^+(aq) + C\ell^-(aq)$ ($HC\ell$ is a monoprotic acid.) $NH_3(g) + H_2O(\ell) \rightarrow NH^+_4(aq) + OH^-(aq)$ $H_2SO_4(aq) + 2H_2O(\ell) \rightarrow 2H_3O^+(aq) + SO^{2}_{4}{}^{-}(aq)$ (H_2SO_4 is a diprotic acid.) •Identify conjugate acid-base pairs forgiven compounds. When the acid, HA, loses a proton, its conjugate base, A^-, is formed. When the base, A^-, accepts a proton, its conjugate acid, HA, is formed. These two are a conjugate acid-base pair. •Describe a substance that can act as either acid or base as amphiprotic or as an ampholyte. Water is a good example of an ampholyte. Write equations to show how an amphiprotic substance can act as acid or base. •Write down neutralisation reactions of common laboratory acids and bases. Examples: $HC\ell(aq) + KOH(aq) \rightarrow KC\ell(aq) + H_2O(\ell)$ $HC\ell(aq) + Na_2CO_3(aq) \rightarrow NaC\ell(aq) + H_2O(\ell) + CO_2(g)$ $HNO_3(aq) + NaOH(aq) \rightarrow NaNO_3(aq) + H_2O(\ell)$ $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(\ell)$ $(COOH)_2(aq) + NaOH(aq) \rightarrow (COO)_2Na_2(aq) + H_2O(\ell)$ $CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(\ell)$ **NOTE:** The above are examples of equations that candidates should be able to write from given information. However, any other neutralisation reaction can be given in the question paper to assess, e.g. stoichiometry calculations. •Determine the approximate pH (equal to, smaller than or larger than 7) of salts in salt hydrolysis. Define *hydrolysis* as the reaction of a salt with water. o Hydrolysis of the salt of a weak acid and a strong base results in an alkaline solution, i.e. the pH > 7. Examples of such salts are sodium ethanoate, sodium oxalate and sodium carbonate.

	o Hydrolysis of the salt of a strong acid and a weak base results in an acidic solution, i.e. the pH < 7. An example of such a salt is ammonium chloride. o The salt of a strong acid and a strong base does not undergo hydrolysis and the solution of the salt will be neutral, pH= 7. • Motivate the choice of a specific indicator in a titration. Choose from methyl orange, phenolphthalein and bromothymol blue. Define the equivalence point of a titration as the point at which the acid /base has completely reacted with the base/acid. Define the endpoint of a titration as the point where the indicator changes color. • Perform stoichiometric calculations based on titrations of a strong acid with a strong base, a strong acid with a weak base and a weak acid with a strong base. Calculations may include percentage purity. • For a titration, e.g. the titration of oxalic acid with sodium hydroxide: o List the apparatus needed or identify the apparatus from a diagram. o Describe the procedure to prepare a standard oxalic acid solution. o Describe the procedure to conduct the titration. o Describe safety precautions. o Describe measures that need to be in place to ensure reliable results. o Interpret given results to determine the unknown concentration. • Explain the pH scale as a scale of numbers from 0 to 14 used to express the acidity or alkalinity of a solution. • Calculate pH values of strong acids and strong bases using pH = -log[H_3O^+]. Define Kw as the equilibrium constant for the ionization of water or the ionic product of water or the ionization constant of water, i.e. Kw = [H_3O^+][OH^-] = 1 x 1014 by 298 K. • Explain the auto-ionization of water, i.e. the reaction of water with itself to form H3O+ ions and OH- ions. • Interpret Ka values of acids to determine the relative strength of given acids. Interpret Kb values of bases to determine the relative strength of given bases. • Compare strong and weak acids by looking at: o pH (monoprotic and diprotic acids) o Conductivity o Reaction rate

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- Be able to use the following Physical Constants and formulae to do acid-base calculations.

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	$p^\ominus$	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	$T^\ominus$	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$c=\frac{n}{V}$ or/*of* $c=\frac{m}{MV}$	$n=\frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b}=\frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	

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<td>ACTIVITIES/
ASSESSMENT</td>
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Experiment (Chemistry) – Titration: (Formal Assessment for Year mark)

- Preparing a standard solution for volumetric analysis (e.g. oxalic acid)
  Link: https://www.youtube.com/watch?v=loxMW2honqw

- Performing acid-base titrations using suitable indicators e.g. oxalic acid against sodium hydroxide with phenolphthalein as indicator.
  Link: https://www.youtube.com/watch?v=sESz70VPGhA

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	• Do acid-base titration calculations (e.g. NaOH vs HCl titration) **Link:** https://www.youtube.com/watch?v=cYsYrFJaSr4 **Online Google Quiz:** **Link: https://forms.gle/6A5rTxyR9K15pevNA** **Revision exercises:** Free State Education Department Revision Doc: (Terms & Definitions, p. 7-8; Exam Questions, p. 52-59; Memorandum, p. 110-116. **Link: https://drive.google.com/open?id=15SbojZ4br1lrr4Tj68e0vhiiQCBChs0o**
CONSOLIDATION	Dear Grade 12 Learner 1. This document was compiled as an extra resource to help you to perform well in Physical Sciences. 2. Firstly you must make sure that you study the terms and definitions provided for each topic. Theory always forms part of any test or examination and you should ensure that you obtain full marks for ALL theory questions. Revise terms and definitions of topics already completed frequently so that you know them by the time you are sitting for a test or an examination. 3. Answer all the questions on a certain topic in your homework book as soon as the topic is completed. DO NOT look at the answers before attempting the questions. First try it yourself. Mark your work with a pencil and do corrections for your incorrect answers. If you do not know how to answer a question, the answers in the memorandum are there to guide you. Acquaint yourself with the way in which a particular type of question should be answered. 4. Any additional resource is only of help when used correctly. Ensure that you make use of all help provided in the correct way to enable you to be successful. All the best for 2020 and may you perform very well in Physical Sciences.

VALUES	The chlorine-alkali (chloralkali) industry is an important part of the chemical industry for the production of chlorine and sodium hydroxide. The uses of chlorine include: • the purification of water • as a disinfectant • in the production of: o paper, food o antiseptics, insecticides, medicines, textiles o paints, petroleum products, solvents, plastics (such as polyvinyl chloride) The uses of sodium hydroxide include: • making soap and other cleaning agents • purification of bauxite (the ore of aluminum) • making paper • making rayon (artificial silk) • production of hair products (hair relaxers and permanent waving of hair)