



SUBJECT and GRADE	Physical Sciences Grade 12	
TERM 4	Week 1	
TOPIC	Chemical Industry	
AIMS OF LESSON	In this topic you will investigate what fertilisers are, why they are important, how they are produced and what their impact on the environment is.	
RESOURCES	Paper based resources	Digital resources
	Learners are referred to the: <ul style="list-style-type: none">• Chemical Industry (Fertilisers) topic in the textbook or study guides (e.g. Answer Series) that learners will have on hand.• Examination Guideline (page 23)• Mind the Gap Chemistry book (pages 202-218)• Past NSC Examination papers (refer to question 10 in paper 2)	Refer to the relevant digital resources: <ul style="list-style-type: none">• WCED ePortal https://wcedportal.co.za• Past NSC Examination papers (refer to question 10 in paper 2) https://wcedonline.westerncape.gov.za/grade-12-question-papers• Telematics https://wcedonline.westerncape.gov.za/edumedia/revision-dvds-telematics• Mind the Gap https://wcedonline.westerncape.gov.za/mind-gap• HeyScience App for Physical Sciences on Play Store• https://www.siyavula.com/read/science/grade-12/the-chemical-industry/14-the-chemical-industry-03
INTRODUCTION	<ul style="list-style-type: none">• Concepts such as neutralisation reactions, chemical equilibrium, Le Chatelier's principle should already be familiar to learners from previous topics in grade 12. Endothermic (energy absorbed) and exothermic (energy released) reactions were also discussed in grade 11.• Fertilisers are used to provide sufficient nutrients to the soil to sustain optimum crop yields. To maintain healthy crops plays an important role in providing enough food for the nation. The fertiliser industry is therefore an important chemical industry in South Africa.• Without fertilisers we might not be able to produce enough food to sustain life on earth. You will learn how inorganic fertilisers are produced and what are the alternatives to the inorganic fertilisers.	

CONCEPTS AND SKILLS

- List, for plants:
 - Three non-mineral nutrients C, H and O and their sources, i.e. from the atmosphere (CO_2) and rain (H_2O) (Mind The Gap (MTG) page 202)
 - Three primary nutrients N, P and K and their sources (MTG page 203)
- Explain why fertilisers are needed. (MTG page 202)
- Explain the function of N, P and K in plants. (MTG page 203)
- Interpret the N : P : K fertiliser ratio and perform calculations based on the ratio. (MTG page 210)
- Describe, explain, write balanced equations (MTG page 204) and interpret flow diagrams (MTG page 207) of the following processes in the industrial manufacture of fertilisers:
 - N_2 – fractional distillation of air
 - H_2 – at SASOL from coal and steam
 - NH_3 – Haber process (MTG page 204)
 - HNO_3 – Ostwald process (MTG page 204)
 - H_2SO_4 – Contact process (MTG page 204)
 - NH_4NO_3 ; $(\text{NH}_4)_2\text{SO}_4$ (MTG page 206)
- Evaluate the use of inorganic fertilisers on humans and the environment. (MTG page 213)
- Define eutrophication as the process by which an ecosystem, e.g. a river or dam, becomes enriched with inorganic plant nutrients, especially phosphorus and nitrogen, resulting in excessive plant growth. As plant growth becomes excessive, the amount of dead and decaying plant material increases rapidly. (as per Examination Guideline page 23)
- Discuss alternatives to inorganic fertilisers as used by some communities. (MTG page 215)

Key points to consider when studying this topic:

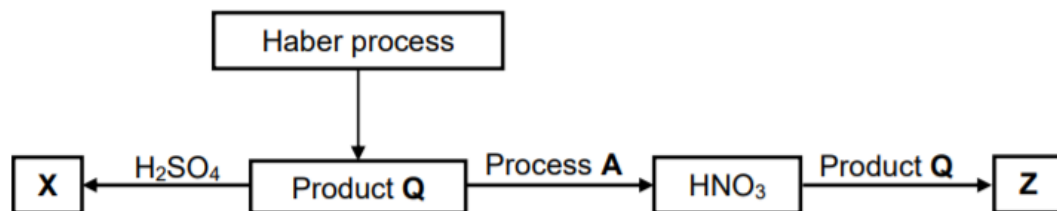
- Highlight and study definitions from the examination guidelines (page 23).
- Only the production of the fertiliser Ammonium sulphate and Ammonium nitrate is examinable according to the examination guideline. (Superphosphates and Urea is not examinable)
- Perform calculations based on the N : P : K ratios (Show each of the calculations).
- When performing N : P : K calculations remember to work with ratios.
- Ensure that you can write the balanced equations of all the reactions used to make the fertilisers as well as interpreting flow diagrams illustrating the different processes.

	<ul style="list-style-type: none"> Common mistakes made: Learners do not state definitions as per examination guideline. In the NPK ratio, learners tend to get confused with what N : P : K refers to i.e. the ratio of Sodium : Phosphorus : Potassium.
ACTIVITIES/ ASSESSMENT	<p>Learners are referred to <i>Chemical Industry activities/assessment</i> that they can complete/do in their <i>Physical Sciences textbooks or Study guides</i>.</p> <p><i>Informal assessment activities in Mind the Gap:</i></p> <ul style="list-style-type: none"> Activity 1 (page 203) Activities 2-5 (page 214-218)
CONSOLIDATION	<p>In this topic you were introduced to the Fertiliser Industry. A fertiliser is a chemical compound that is given to a plant to promote growth. Inorganic fertilisers are produced industrially in the Haber, Contact & Ostwald processes at chemical plants like SASOL. Fertiliser packaging contains a set of numbers, for example 6:2:3 (25). These numbers are called the NPK ratio, and they give the mass ratio of nitrogen, phosphorus and potassium in the fertiliser. The NPK ratio expresses the content of each nutrient as a percentage of N, P and K in this order. A number in brackets after this ratio indicates the percentage by mass of N, P and K that is present in the fertiliser (what percentage of the total fertiliser is N, P and K). It will be expected of you to perform calculations based on the NPK ratios. Organic fertilisers are not manufactured by man, but come from natural sources e.g. manure, blood and bones, guano, compost and kelp products. Organic fertilisers contain lower levels of nutrients and might take longer than inorganic fertilisers to be absorbed but the advantage of organic fertilisers is that they increase the organic component of the soil. Fertilisers helps provide the nutrients that we need to ensure healthy crops to sustain life on Earth but excessive use of fertilisers can also harm the environment. Fertilisers can have a damaging effect on the environment when they are present in high quantities in ecosystems. This can lead to eutrophication. Eutrophication refers to an over-supply in chemical nutrients (such as nitrogen and phosphorus) in an ecosystem, leading to the depletion of oxygen in a water system through excessive plant growth.</p>
VALUE	<p>The fertiliser industry is a very important industry in South Africa and in the world. The need for fertilisers is increasing due to the growth in the world population and the decrease in available agricultural land. Less land means the available land must produce a lot of high quality food at a high rate (fast). The nutrients in the soil are used by the plants that grow and these nutrients must constantly be replaced. The fertiliser industry is very important in providing fertilisers with the correct nutrients in the correct quantities to ensure maximum growth for various plants and crops.</p>

CONSOLIDATION QUESTION

[DBE NSC EXAMINATION FEB/MAR 2018]

1.1 The diagram below shows processes involved in the production of fertiliser **X** and fertiliser **Z**.



Write down the:

- 1.1.1 Balanced equation for the formation of product Q (3)
- 1.1.2 FORMULA of fertiliser X (1)
- 1.1.3 NAME of process A (1)
- 1.1.4 NAME of fertiliser Z (1)
- 1.2 A 10 kg bag of NPK fertiliser is labelled 6 : 1 : 5 (22).
- 1.2.1 What is the meaning of NPK? (1)
- 1.2.2 What is the meaning of (22) on the label? (1)
- 1.2.3 Calculate the mass of potassium in the bag. (4)

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CONSOLIDATION QUESTION MEMORANDUM

1.1.1 $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \checkmark \rightarrow 2\text{NH}_3(\text{g}) \checkmark$ bal \checkmark (3)

1.1.2 $(\text{NH}_4)_2\text{SO}_4 \checkmark$ (1)

1.1.3 Ostwald process/Ostwaldproses \checkmark (1)

1.1.4 Ammonium nitrate/Ammoniumnitraat \checkmark (1)

1.2.1 The ratio of nitrogen (N), phosphorous (P) and potassium (K) in a certainfertiliser. \checkmark

Die verhouding van stikstof (N), fosfor (P) en kalium (K) in 'n sekere kunsmis. (1)

1.2.2 Percentage fertiliser in the bag./Persentasie kunsmis in die sak. \checkmark (1)

1.2.3 (4)

<p><u>OPTION 1/OPSIE 1:</u></p> $\% \text{K} = \frac{5}{12} \checkmark \times 22\% \checkmark$ $= 9,17\%$ $\therefore m(\text{N}) = \frac{9,17}{100} \times 10 \text{ kg} \checkmark$ $= 0,92 \text{ kg} \checkmark$	<p><u>OPTION 2/OPSIE 2:</u></p> <p>m(nutrients/voedingstowwe):</p> $\frac{22}{100} \checkmark \times 10 = 2,2 \text{ kg}$ <p style="text-align: center;">↓</p> $\therefore m(\text{K}) = \frac{5}{12} \checkmark (2,2) \checkmark$ $= 0,92 \text{ kg} \checkmark$
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