

Study & Master

Support Pack | Grade 12

CAPS

Physical Sciences

Chemical systems

This support pack for the **Chemical systems** module in the **Physical Sciences Grade 12 CAPS curriculum** provides valuable practice exercises. All questions have the answers provided. Learners can work through these individually at home or these could form the basis of a catch-up class or online lesson. You have permission to print or photocopy this document or distribute it electronically via email or WhatsApp.

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Revision exercises for Chemical systems

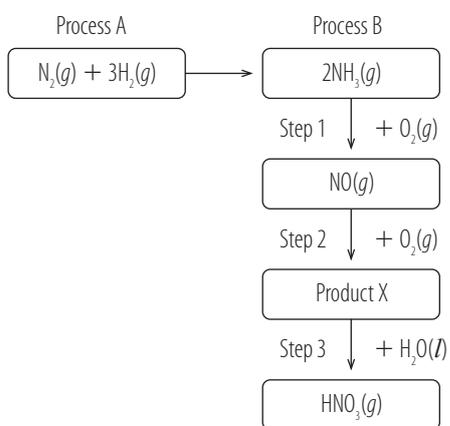
Question 1

Name the following substances:

- the acid produced in the final stages of the contact process
- the solution that is reacted with carbon dioxide to produce urea
- the catalyst used in the Haber process
- the acid produced in the final stages of the Ostwald process.

Question 2

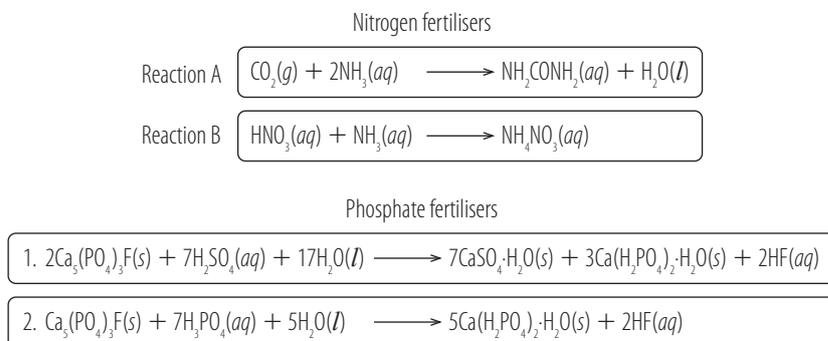
Nitric acid is prepared industrially by a sequence of chemical steps, including the Haber and Ostwald processes. Consider the flow diagram below.



- What is the name given to Process A?
- Refer to Step 1 in Process B.
 - Give a fully balanced equation for this step.
 - This step is performed in the presence of platinum. Give a reason for this.
- Write down the name of Product X formed in Step 2.
- Name the fertiliser formed when the nitric acid is reacted with ammonia solution.

Question 3

The diagram below shows some of the methods of manufacturing fertilisers.



- What is the common name of the product NH_2CONH_2 formed in Reaction A of the nitrogen fertilisers?
- What is the name of the product NH_4NO_3 formed in Reaction B of the nitrogen fertilisers?

- c) Another reaction involving the production of nitrogen fertilisers is the reaction of ammonia with sulfuric acid to produce ammonium sulfate. Write down the chemical formula for ammonium sulfate.
- d) Too much nitrogen fertiliser in the soil can lead to nitrogen pollution. This is due to the conversion of nitrates into another nitrogen ion. Name this ion.
- e) The production of phosphate fertilisers depends on adding either sulfuric acid or phosphoric acid to the compound $\text{Ca}_5(\text{PO}_4)_3\text{F}$. What is the common name of this compound?
- f) Both end products of the reactions in the production of phosphate fertilisers are $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$. In Reaction 1, this substance is called single superphosphate, while in Reaction 2 it is called double superphosphate. Explain why this is so.

Question 4

A 25 kg bag of NPK fertiliser is marked '2:3:4 (24%)'.

- a) Calculate the mass, in kg, of nitrogen, phosphorus and potassium in the bag.
- b) Would this bag contain more mass of phosphorus than a 25 kg of NPK bag marked '5:1:5 (45%)'? Explain your answer.

Question 5

List three differences between organic and inorganic fertilisers.

Question 6

Explain the term 'eutrophication' and the consequences of this to aquatic life.

Memorandum for revision exercises

- 1
 - a) sulfuric acid
 - b) ammonia
 - c) iron powder
 - d) nitric acid
- 2
 - a) the Haber process
 - b
 - i) $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$
 - ii) The platinum acts as a catalyst.
 - c) nitrogen dioxide
 - d) ammonium nitrate
- 3
 - a) urea
 - b) ammonium nitrate
 - c) $(\text{NH}_4)_2\text{SO}_4$
 - d) nitrite ion
 - e) fluorapatite
 - f) There is no gypsum ($\text{CaSO}_4 \cdot \text{H}_2\text{O}$) to dilute the superphosphate.
- 4
 - a) N: 1,33 kg; P: 2 kg; K: 2,67 kg
 - b) No. Although this bag contains more fertiliser per bag (45%), the fraction of phosphorus is only $\frac{1}{11}$ (i.e. 1 kg) compared to $\frac{3}{9}$ (i.e. 2 kg) in the first bag.
- 5
 - Organic fertilisers contain carbon, while inorganic fertilisers do not contain carbon, but have N, P and K in various fixed ratios.
 - Organic fertilisers are derived mainly from plant remains or animal excretions, while inorganic fertilisers are manufactured in chemical processing plants.
 - Organic fertilisers contain small amounts of plant nutrients, while inorganic fertilisers have accurate and predetermined plant nutrients.
- 6 Eutrophication is the enrichment of water by the addition of nutrients. The extra nutrients encourage the growth of blue-green algae in the water. These algae may produce toxins that are poisonous to fish, animals and humans. When the algae die and decompose, the oxygen level of the water decreases, which leads to the death of aquatic life.