Unit 17 · Modern Chemical Manufactures

WORKSHEET

Full marks 34

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 34

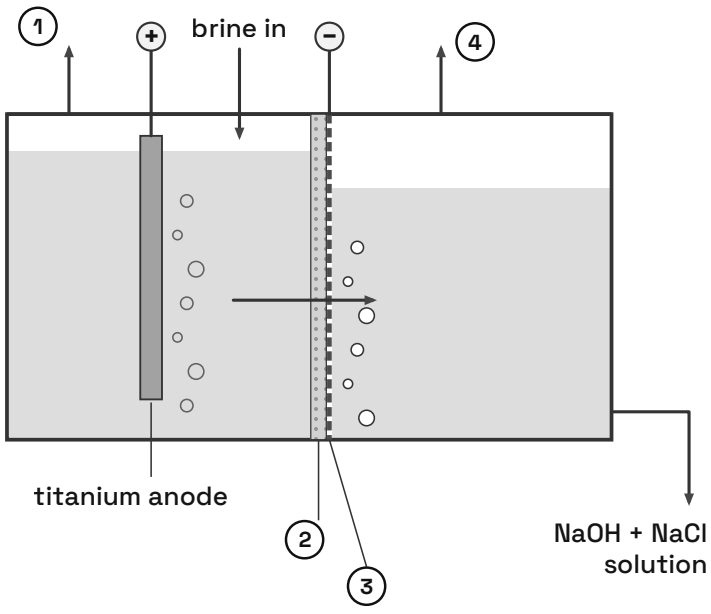
1 Match the columns [3]

Match each term in Column A with its meaning in Column B. One meaning in Column B is not needed. Each carries 0.5 mark.

Column A		Column B
1. oleum	☐	**a.** small round beads of urea made by letting molten drops fall through air
2. promoter	☐	**b.** a huge growth of algae in water fed by washed-out nitrate and phosphate
3. prills	☐	**c.** sulphur trioxide absorbed in concentrated sulphuric acid, $H_2S_2O_7$
4. biuret	☐	**d.** a substance such as K_2O that makes a catalyst work better and last longer
5. cell liquor	☐	**e.** a solution of ammonia in water
6. eutrophication	☐	**f.** an impurity formed when molten urea is held hot too long, harmful to seedlings
		g. the solution of about 10–12% NaOH with salt drawn from a diaphragm cell

2 Label the diagram [2]

The diagram shows a diaphragm cell. Write what belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. The promoters added to the iron catalyst in Haber's process are: [1]

a. V_2O_5 and K_2SO_4 **b.** K_2O and Al_2O_3
c. platinum and rhodium **d.** nickel and alumina

ii. In the Solvay process, the only waste product is: [1]

a. ammonium chloride **b.** sodium hydrogencarbonate
c. calcium chloride **d.** carbon dioxide

iii. In Ostwald's process, the gas from the converter is cooled before it reaches the oxidation chamber, because: [1]

a. nitric oxide decomposes when hot
b. the reaction $2NO + O_2 \rightarrow 2NO_2$ goes faster at lower temperatures
c. platinum must be kept cool
d. nitric acid boils at a low temperature

iv. In the contact process, arsenic oxide is removed from the gas by: [1]

a. concentrated sulphuric acid **b.** an electrostatic precipitator
c. moist iron(III) hydroxide **d.** a beam of light

v. A farmer's crop has weak roots and is slow to flower and set seed. Which nutrient is it most likely short of? [1]

a. nitrogen **b.** phosphorus
c. potassium **d.** magnesium

4 Short answers [9]

Write short answers to the following questions.

a. In the contact process, why is sulphur trioxide absorbed in 98% sulphuric acid instead of in water? Write the two equations that follow. [2]

b. Give two reasons why the diaphragm is needed in a diaphragm cell. [2]

c. Write two advantages and two disadvantages of urea as a fertilizer. [2]

d. What is eutrophication? Explain how too much fertilizer on fields can kill the fish in a pond. **[3]**

5 Long answer **[4]**

Write a long answer to the following question.

Describe the manufacture of nitric acid by Ostwald's process, with an equation for each step, and say how the acid is concentrated to about 98%.

6 Numerical problems **[8]**

Solve the following problems. Show your working. Take H = 1, N = 14, O = 16, P = 31, S = 32, K = 39, and the molar volume of a gas at STP as 22.4 L.

a. A contact plant burns 64 tonnes of sulphur a day, and all of it ends up as sulphuric acid. i. Write the equations for the three steps from sulphur to sulphuric acid (taking $SO_3 + H_2O \rightarrow H_2SO_4$ as the overall result of the oleum steps). ii. Find the mass of H_2SO_4 made each day. iii. Find the mass of oxygen used, and its volume at STP. **[4]**

Answer:

b. A 50 kg sack of NPK fertilizer is labeled 15 : 15 : 15. i. Find the mass of nitrogen in it. ii. Find the mass of phosphorus (counted as P_2O_5) and of potassium (counted as K_2O) it actually contains. iii. What mass of urea would give the same mass of nitrogen? **[4]**

Answer: _____

7 Think **[3]**

High pressure favors the products both in Haber's process and in the contact process, yet Haber plants run at about 200 atm and contact plants at only 1–2 atm. Explain the difference.

8 Activity: Sacks in the shop (not marked)

Visit an agrovet shop (or look at sacks at home) and read the labels of three or four fertilizers.

Name on the sack	Formula or type	Numbers on the label (N : P_2O_5 : K_2O, or % N)	Main nutrient it gives

Which fertilizer gives the most nitrogen per kilogram? How should it be stored and used so that its nitrogen is not lost?