Summary Quiz (Chapter 44)

Section A: Multiple Choice

1. Which of the following processes is related to the manufacture of fertilizers?
   (1) Reichstein process
   (2) Ostwald process
   (3) Haber process
   A. (1) and (2) only
   B. (1) and (3) only
   C. (2) and (3) only
   D. (1), (2) and (3)

2. Which of the following are industrial uses of chlorine?
   (1) Making domestic bleach
   (2) Making hydrochloric acid
   (3) Sterilizing water
   A. (1) and (2) only
   B. (1) and (3) only
   C. (2) and (3) only
   D. (1), (2) and (3)

3. Which of the following half equations correctly shows the reaction occurring at the anode of a membrane cell?
   A. $2H_2O(l) + 2e^- \longrightarrow H_2(g) + 2OH^-(aq)$
   B. $2H^+(aq) + 2e^- \longrightarrow H_2(g)$
   C. $2Cl^-(aq) \longrightarrow Cl_2(g) + 2e^-$
   D. $4OH^-(aq) \longrightarrow 2H_2O(l) + 4e^- + O_2(g)$

Questions 4 and 5 refer to the flowing mercury cell in the chloroalkali industry.

4. What are the materials commonly used as the anode and cathode of the flowing mercury cell?

	Anode	Cathode
A.	Mercury	Titanium
B.	Nickel	Steel
C.	Titanium	Nickel
D.	Titanium	Mercury

5. Which of the following statements about a flowing mercury cell is INCORRECT?
   A. It uses concentrated sodium chloride solution as the raw material.
   B. Sodium amalgam forms in the cell.
   C. Chlorine gas forms at the cathode.
   D. It produces concentrated sodium hydroxide solution of high purity.

6. Which of the following statements about methanol is INCORRECT?
   A. It is the first member in the alcohol series.
   B. It is a colourless gas at room conditions.
   C. It is highly flammable.
   D. It can be used as a solvent.

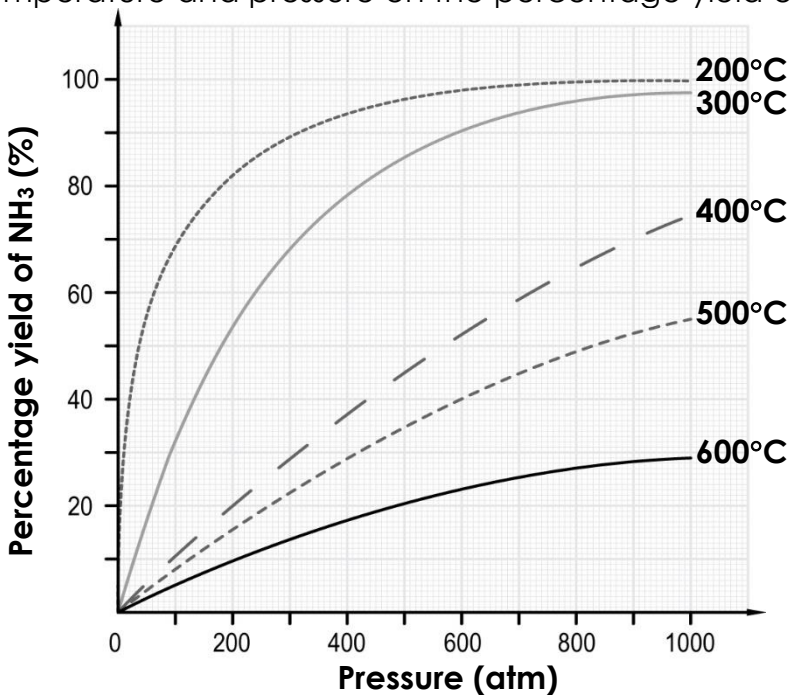
7. Which of the following are the conditions for steam-methane reforming to give syngas?
   (1) The pressure used is 10–20 atm.
   (2) The temperature used is 700–1000°C.
   (3) The catalyst used is nickel metal.

   A. (1) and (2) only
   B. (1) and (3) only
   C. (2) and (3) only
   D. (1), (2) and (3)

8. Which of the following compounds is absent in syngas?
   A. Carbon monoxide
   B. Carbon dioxide
   C. Hydrogen
   D. Water vapour

Section B: Structural Question

Haber process is the first step to manufacture fertilizers. The following diagram shows the effect of temperature and pressure on the percentage yield of ammonia:



(a) State and explain whether the manufacture of ammonia is an exothermic reaction or an endothermic reaction.

(b) Ammonium phosphate is a fertilizer. Write an equation for its manufacture.

(c) Urea (*X*) is manufactured from ammonia and carbon dioxide according to the following equation: $2NH_3 + CO_2 \longrightarrow X + H_2O$
Give the chemical formula of urea.

(d) By calculating the percentage by mass of nitrogen in ammonium phosphate and urea, deduce which compound is a better nitrogenous fertilizer.
(Relative atomic masses: H = 1.0, C = 12.0, N = 14.0, O = 16.0, P = 31.0)

The End

Suggested Answer

Section A

1.	C	5.	C
2.	D	6.	B
3.	C	7.	A
4.	D	8.	D

Section B

(a) The manufacture of ammonia is an exothermic reaction.
From the graph, a low temperature favours the manufacture of ammonia. A low temperature favours exothermic reaction.

(b) $3NH_3 + H_3PO_4 \longrightarrow (NH_4)_3PO_4$

(c) $(NH_2)_2CO$

(d) Percentage by mass of nitrogen in $(NH_4)_3PO_4$
= 14.0 x 3 / (14.0 x 3 + 1.0 x 12 + 31.0 + 16.0 x 4) x 100%
= 28.2%

Percentage by mass of nitrogen in $(NH_2)_2CO$
= 14.0 x 2 / (14.0 x 2 + 1.0 x 4 + 12.0 + 16.0) x 100%
= 46.7%

As urea has a higher nitrogen content, it is a better nitrogenous fertilizer.

The End