ST ANDREW'S SECONDARY SCHOOL

NAME _____ CLASS _____

DATE _____

CHEMISTRY

18.1 The Haber Process

Assessment for Learning

AMMONIA

1 The equation shows the reaction for the manufacture of ammonia.

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g)$$

Which change will **not** increase the yield of this reaction?

A Addition of Fe catalyst
B Decrease in temperature
C Increase in molar volumes of each reactant
D Increase in pressure

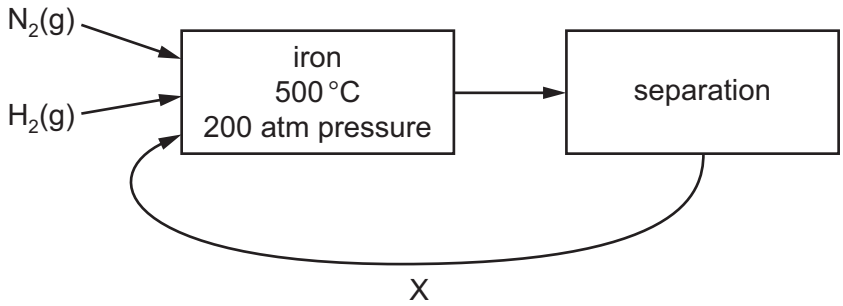
2 In the Haber process, nitrogen and hydrogen react to form ammonia.

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g) \qquad \Delta H = -92\ kJ$$

Which factor increases **both** the speed of reaction **and** the amount of ammonia formed?

A Addition of Fe catalyst
B Decrease in temperature
C Increase in pressure
D Increase in temperature

3 The diagram shows the main stages in the manufacture of ammonia.



Which of the following best describes the process labelled X?

A Ammonia is returned to the start of the process to form a larger amount of the product.
B The gases are cooled to cause ammonia to form a liquid.
C Unreacted hydrogen only is recycled.
D Unreacted hydrogen and nitrogen are recycled.

4 How is the reaction between nitrogen and hydrogen be described as?

A A neutralisation reaction
B A reduction reaction
C A reversible reaction
D An oxidation reaction

5 Which statement is **not** correct about the Haber process?

A An iron catalyst is used.
B Each nitrogen molecule reacts with three hydrogen atoms to form a molecule of ammonia.
C Hydrogen for the process can be obtained by the cracking of oil.
D The reaction is reversible.

6 Hydrogen and nitrogen react to form ammonia.

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g)$$

Which statement is correct?

A Ammonia is made in industry by the Contact process.
B Ammonia is used in the industry to make hydrogen and nitrogen.
C Hydrogen, for the forward reaction, is obtained from cracking of oil.
D Weed killers are manufactured from ammonia.

7 Ammonia is manufactured by the Haber process.

$$N_2\,(g) + 3\,H_2\,(g) \rightleftharpoons 2\,NH_3\,(g) \qquad \Delta H = -92\ \text{kJ}$$

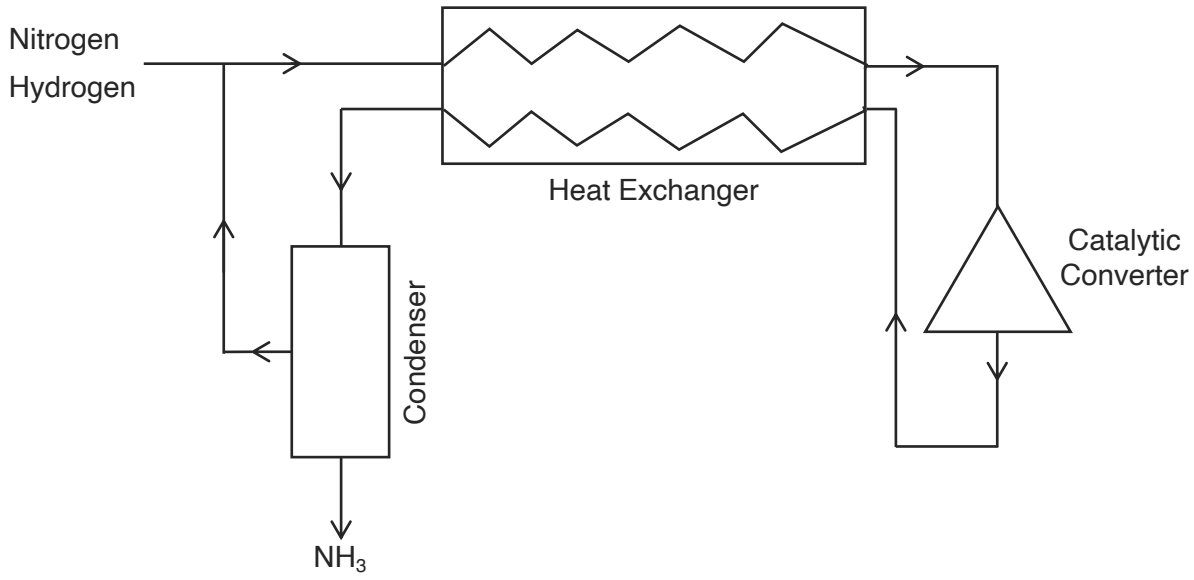
For this reaction, which rows give a true statement together with a correct reason?

	Statement	Reason
1	Nitrogen and hydrogen are mixed in the ratio 1:3 by volume.	The formula of ammonia is NH_3.
2	The pressure used is approximately 200 atm.	A high pressure is needed to produce a good yield of ammonia at equilibrium.
3	The temperature used is approximately 450 °C.	A high temperature is needed to produce a good yield of ammonia at equilibrium.
4	Vanadium(V) oxide is used as the catalyst.	A catalyst speeds up the rate of the reaction.

A 1, 2 and 3 only
B 1 and 2 only
C 2 and 3 only
D 3 and 4 only

Use the information provided below to answer questions **8** – **10**.

The Haber process is used to produce ammonia from hydrogen and nitrogen on an industrial scale. The diagram shows an illustration of this process.



8 What is the purpose of the heat exchanger?

A To cool the incoming gas mixture to avoid overheating the catalyst.
B To cool the incoming gas mixture to produce more ammonia.
C To cool the reaction products and separate the ammonia from unused reactants.
D To warm the incoming gas mixture to produce more ammonia.

9 Which substance is **most** suitable for use in the catalytic converter?

A 1 g of granular iron
B 1 g of powdered iron
C 1 g of powdered nickel
D 1 g of powdered vanadium

10 Which statement is **not** correct about this process?

A Ammonia has a higher boiling point than hydrogen or nitrogen.
B Ammonia has a lower boiling point than hydrogen or nitrogen.
C Ammonia is collected in its liquid state.
D The yield of this process never reaches 100 %.