



## New Document 1

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **9 minutes**

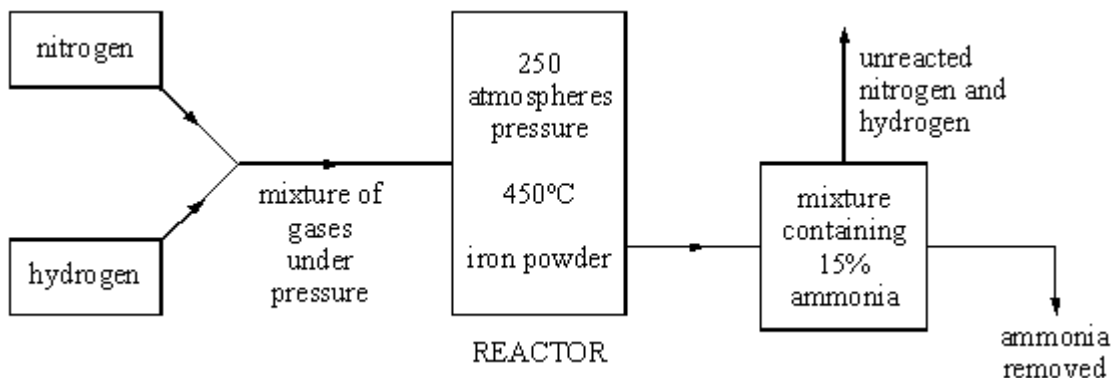
Marks: **9 marks**

Comments:

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**Q1.**

Ammonia is manufactured from nitrogen and hydrogen in the Haber Process. The diagram shows some details of the manufacturing process.



- (a) Nitrogen is obtained from the air.  
From where is the hydrogen obtained?

\_\_\_\_\_ (1)

- (b) What happens to the unreacted nitrogen and hydrogen?

\_\_\_\_\_  
\_\_\_\_\_ (1)

- (c) Ammonium nitrate is made from ammonia.

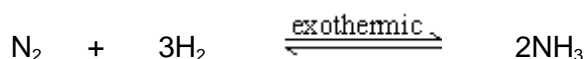
Farmers spread nitrates on to soil to make crops grow better.

The nitrates may get into people's bodies even if they do not eat the crops.

Explain how this can happen.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

- (d) The equation for the Haber Process is this:



At equilibrium, nitrogen, hydrogen and ammonia are present in the reactor.

- (i) What is meant by 'equilibrium'?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(ii) Explain, as fully as you can, why:

- the yield of ammonia decreases with increase in temperature,
- despite this fact, a comparatively high temperature of 450°C is used for the industrial process,
- iron powder is added to the reactor.

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(4)

(Total 9 marks)

## Mark schemes

### Q1.

- (a) from natural gas [*allow from water/ steam / brine / river / lake / sea*]  
*for 1 mark* 1
- (b) *idea that they are recycled / re-used*  
*for 1 mark* 1
- (c) *ideas that*
- nitrates may get into ground water / rivers
  - so contaminate / get into our drinking water
  - eating animals which have eaten crop/ or eating contaminated fish  
*[do not allow 'eutrophication']*  
*any two for 1 mark each* 2
- (d) (i) *idea that*  
when rate of forward = rate of reverse reaction  
[not just 'reversible' or 'can be reversed']  
*[allow ammonia is breaking up into nitrogen and hydrogen  
as fast as nitrogen and hydrogen are forming ammonia  
or amounts of products and reactants stay constant]*  
*for 1 mark* 1
- (ii) *ideas that*
- at higher temperatures, equilibrium moves to **the left**  
**or** reverse / endothermic
  - reaction / favoured **or** makes products → reactants
  - but at lower temperatures the (rate of) reaction is (very) slow
  - so a higher temperature is used for economic reasons/so ammonia is produced at higher rate
  - iron powder is a catalyst / speeds up the reaction  
*[not increases the yield]*
  - low yield not wasteful if reactants re-cycled  
*[credit iron powder has a greater surface area]*  
*each for 1 mark* 4