EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Level: CIE AS and A Level (9701)
Subject: Chemistry
Topic: CIE Chemistry
Type: Mark Scheme

Chemistry CIE AS & A Level
To be used for all exam preparation for 2025+

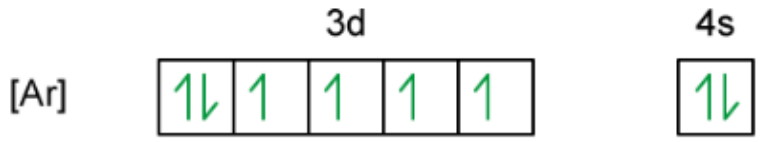
CHEMISTRY AS and A

This to be used by all students studying CIE AS and A level Chemistry (9701) But students of other boards may find it useful

Mark Scheme

Answer 1.

a) The electron configuration for an atom of $^{28}_{56}Fe$ is:



- Correct electron box notation; [1 mark]

[Total: 1 mark]

- Iron has an argon core, [Ar], and 8 electrons arranged as $4s^2$ $3d^6$

b) In the Haber process, iron is:

- A heterogeneous catalyst
  AND
  (Because,) it is in a different state / phase to the reactants; [1 mark]

[Total: 1 mark]

- Since iron is powder-coated, it is a solid
- In the Haber process, nitrogen gas and hydrogen gas react to form ammonia
- Therefore, iron is a heterogeneous catalyst because it is in a different state / phase to the reactants

c) The mode of action of a heterogeneous catalyst in a reaction is:

- Reactants **adsorb** to the surface of the catalyst; [1 mark]
- The bonds in the reactants weaken; [1 mark]
- The reaction occurs
  AND
  The products are desorbed; [1 mark]

[Total: 3 marks]

- The mode of action of a heterogeneous catalyst is a standard 3 mark question
- Examiners are looking for the 3 specific points given in the mark scheme; adsorb, weaken, desorb

Answer 2.

b) The mode of action for a homogeneous catalyst is:

- The formation of an intermediate complex (between the catalyst and reactants); [1 mark]
- Which lowers the activation energy; [1 mark]
- The complex breaks down to release the products
  AND
  The catalyst is regenerated; [1 mark]

[Total: 3 marks]

- The mode of action of a homogeneous catalyst is a 3 mark question
  - The mode of action of a heterogeneous catalyst is more common
- Examiners are looking for the 3 specific points given in the mark scheme
  1. Formation of an intermediate
  2. A lower activation energy
  3. Products forming as the catalyst is regenerated

b) The mode of action for a homogeneous catalyst is:

- The formation of an intermediate complex (between the catalyst and reactants); [1 mark]
- Which lowers the activation energy; [1 mark]
- The complex breaks down to release the products
  AND
  The catalyst is regenerated; [1 mark]

[Total: 3 marks]

- The mode of action of a homogeneous catalyst is a 3 mark question
  - The mode of action of a heterogeneous catalyst is more common
- Examiners are looking for the 3 specific points given in the mark scheme
  1. Formation of an intermediate
  2. A lower activation energy
  3. Products forming as the catalyst is regenerated

c) Advantages and limitations of using homogeneous catalysts in industrial processes are:

Advantages:

Any **one** of the following:

- Homogeneous catalysts often exhibit high selectivity
  OR
  Homogeneous catalysts have less / fewer unwanted side reactions; [1 mark]
- They can operate at lower temperatures / pressure
  OR
  They can reduce energy consumption; [1 mark]
- They can be easily controlled; [1 mark]

Limitations:

Any **one** of the following:

- Separation / purification of the products can be challenging / expensive / time-consuming; [1 mark]
- The catalyst can become poisoned; [1 mark]

[Total: 2 marks]

- Advantages and limitations of homoegeneous and heterogeneous catalysts is not a very common question but you still need to know them, just in case

Answer 3.

a) A catalyst used during cracking is:

- Aluminium oxide / alumina / Al_2O_3
  OR
  Aluminosilicates
  OR
  Zeolite
  OR
  (Hot) pumice stone
  OR
  Porous / ceramic pot; [1 mark]

[Total: 1 mark]

- Although cracking is from an earlier section of the specification, it involves the use of a catalyst which means that it could be asked about in this topic
- The most common answers are aluminium oxide and zeolite

b) The type of catalyst used in cracking is:

- Heterogeneous
  AND
  (Because,) it is in a different state / phase to the reactants; [1 mark]

[Total: 1 mark]

- The catalyst used in cracking is a solid
- The hydrocarbons are heated to high temperatures ready for cracking, which means that they are vapours / gaseous
- Therefore, the catalyst is heterogeneous as it is in a different state / phase to the reactants

c) A powdered catalyst is more effective because:

- It has a greater surface area; [1 mark]
- So, there are more places / points / active sites (for adsorption); [1 mark]

[Total: 2 marks]

- This question requires you to:
  - Recognise that using a powdered catalyst is increasing the surface area
  - Combine ideas about collision theory with the mode of action of a heterogeneous catalyst, i.e. greater surface area = more sites for adsorption to occur