# End of topic quiz

# Topic C5: Monitoring and controlling chemical reactions

## Instructions and answers for teachers

These instructions cover the learner activity section which can be found on [page 11](#_Chapter:_P4_of). This end of topic quiz supports OCR GCSE (9–1) Combined Science A (J250), Topic C5.

**When distributing the activity section to the learners either as a printed copy or as a Word file you will need to remove the teacher instructions section.**

### The Activity

This end of topic quiz comprises of 40 marks covering a range of question types. The quiz starts with some multiple choice questions and them moves on to some short answer questions and then finally on to some longer answer questions.

The question worksheet can be used to consolidate understanding at the end of teaching the topic, to revisit and refresh knowledge at a later point in the course, or during exam preparation.

### Learning Outcomes

This end of topic quiz relates to the specification learning outcomes in Topic C5: Monitoring and controlling chemical reactions. The quiz covers the following topics:

C5.1 Controlling chemical reactions

C5.2 Equilibria

### Topic: C5 of J250 - Answers

**Total marks: 40**

1. During the Haber process, hydrogen and nitrogen gas are converted into ammonia.



Here is the equation for the reaction.

H2 (g) + N2 (g)  2NH3 (g)

Iron is also added to the reaction. The iron acts as a catalyst.

How can a catalyst increase the rate of reaction? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Lowers the activation energy for the reaction to occur |  |
| **B** | Removes any excess reactants from the reaction |  |
| **C** | Raises the temperature of the reaction |  |
| **D** | Reduces the production of any unwanted chemicals |  |

Your answer

**A**

1. The sign  means that a reaction is… **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Complete |  |
| **B** | Incomplete |  |
| **C** | Irreversible |  |
| **D** | Reversible |  |

Your answer

**D**

1. Anna tests four powders to find a catalyst for the reaction of zinc with sulphuric acid.

Zn + H2SO4 🡪 ZnSO4 + H2

Here are her results.

| **Powder** | **Powder colour at start** | **Powder colour at end** | **Volume of gas made (cm3)** |
| --- | --- | --- | --- |
| **1** | orange | orange | 5 |
| **2** | green | black | 50 |
| **3** | black | black | 50 |
| **4** | blue | blue | 30 |

Which powder is the best catalyst for the reaction? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | 1 |  |
| **B** | 2 |  |
| **C** | 3 |  |
| **D** | 4 |  |

Your answer

**C**

1. Enzymes are biological catalysts, used in processes such as brewing. Yeast contains an enzyme which reacts with glucose to produce alcohol.

Which of these factors **will not** affect the rate of reaction? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Temperature |  |
| **B** | pH |  |
| **C** | Light intensity |  |
| **D** | Glucose concentration |  |

Your answer

**C**

1. A student is looking at the rate of reaction of hydrochloric acid reacting with sodium thiosulfate at different temperatures.

Here is a graph of his results.

Graph: rate of reaction of hydrochloric acid reacting with sodium thiosulfate at different temperatures

What is the trend of this graph? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | The higher the temperature the slower the reaction. |  |
| **B** | The higher the temperature the faster the reaction. |  |
| **C** | The temperature does not affect the rate of reaction. |  |
| **D** | The lower the temperature the faster reaction. |  |

Your answer

**B**

1. A student sets up apparatus to measure the volume of gas produced when marble chips are reacted with hydrochloric acid.

Which piece of apparatus would you use to measure the volume of gas produced? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Beaker |  |
| **B** | Gas syringe |  |
| **C** | Pipette |  |
| **D** | Balance |  |

Your answer

**B**

1. The equation shows the reaction of copper carbonate with hydrochloric acid.

CuCO3 (s) + 2HCl(aq) CuCl2 (aq) + H2O (l) + CO2 (g)

The rate of this reaction can be increased by various different methods.

|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** |  | Why will increasing the temperature of the reaction increase the rate? **[4 marks]** | |
|  |  | (particles) have more energy ✓  (particles) move more quickly ✓  (particles) collide more often ✓  (particles) have energy greater than activation energy/more chance of successful collisions ✓ | |
|  |  |  |  |
| **(b)** |  | Why will increasing the concentration of the reactants increase the rate? **[3 marks]** | |
|  |  | More (particles) in reaction ✓  Greater chance of (particles) colliding ✓  More (particles), so more are likely to have energy greater than activation energy/more change of successful collisions ✓ | |
|  |  |  |  |
| **(c)** |  | Why will cutting the CuCO3 into smaller pieces increase the rate? **[3 marks]** | |
|  |  | Increases surface area ✓  More particles exposed to surface ✓  Greater chance of particles successfully colliding ✓ | |

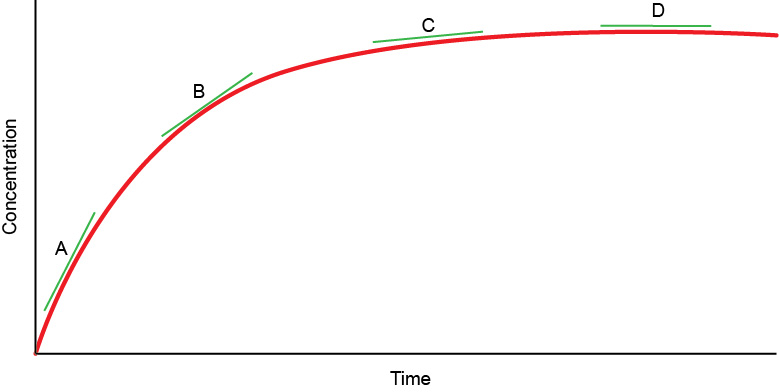
1. The Haber process is where hydrogen and nitrogen are reacted to produce ammonia.

3H2 (g) + N2(g)   2NH3(g)

The production of ammonia is an **exothermic** process.

|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** |  | This reaction is in **dynamic equilibrium**.  What is a dynamic equilibrium? **[1 mark]** | |
|  |  | A reaction where the rates of the forward and backward reactions are equal ✓ | |
|  |  |  |  |
| **(b)** | **(i)** | It has been found that if the reaction is heated too much the production of ammonia drops. Due to this, a compromise temperature of 450 oC is used.  Why does the yield of ammonia drop when the reaction is heated? **[2 marks]** | |
|  |  | The (forward) reaction is exothermic ✓  When heated, the equilibrium will shift to the left to minimise increase in temperature ✓ | |
|  |  |  |  |
|  | **(ii)** | Changing the pressure will also affect the yield of ammonia produced.  How and why should the pressure be changed to increase the yield? **[2 marks]** | |
|  |  | Increase pressure ✓  Reaction shifts to side with the fewest moles to minimise pressure increase/shifts to right (product) ✓ | |
|  |  |  |  |
|  | **(iii)** | 10gof hydrogen reacts with excess nitrogen gas.  If only 28% of the hydrogen is converted into ammonia, what mass of ammonia is produced? Include units and give your answer to 3 significant figures.  **[5 marks]** | |
|  |  | Nos of moles of hydrogen = 10 ÷ 2 = 5 ✓  Max moles of ammonia produced = 2/3 × 5 = 3.33… ✓  Max mass of ammonia produced = 3.33… × 17 = 56.666… ✓  28% of ammonia produced = 15.866… ✓  = 15.9 g to 3 sig figs ✓  (or ✓✓✓✓✓for other correct methods)  Or if answer of 15.9 g is give without working award ✓✓✓✓✓ | |

1. During a chemical reaction, the change in concentration was recorded over the duration of the reaction.



|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** | **(i)** | At which part of the graph, **A**, **B** or **C**, is the rate of reaction the greatest?  **[1 mark]** | |
|  |  | A ✓ | |
|  |  |  |  |
|  | **(ii)** | What happens to the reaction at the end of the graph, **D**? **[1 mark]** | |
|  |  | The reaction has completed/all reactants have reacted ✓ | |
|  |  |  |  |
| **(b)** |  | On the graph above, draw an additional line for a reaction using the **same quantities** of reactants, but at a lower temperature. **[2 marks]** | |
|  |  | Graph should have a lower gradient ✓  End point of graph should level off at same height as original ✓ | |
|  |  |  |  |
| **(c)** | **(i)** | A student investigates the rate of reaction for the reaction of hydrochloric acid and iron by recording the volume of hydrogen produced.  6HCl (aq) + 2Fe (s) FeCl3(aq) + H2 (g)  Here are his results.   | **Time (Mins)** | **Volume of Hydrogen (cm3)** | | --- | --- | | 0 | 0 | | 1 | 14 | | 2 | 25 | | 3 | 34 | | 4 | 36 | | 5 | 39 | | 6 | 41 | | 7 | 41 | | 8 | 41 | | 9 | 41 |   Plot a graph of the student’s results on the grid below. **[4 marks]** | |
|  |  | Correctly labelled x axis (including units) ✓  Correctly labelled y axis (including units) ✓  Correctly plotted points (within 1 square) ✓  Line of best fit included ✓ | |
|  |  |  |  |
|  | **(ii)** | Find the average rate of reaction from the data, or your graph. **[2 marks]** | |
|  |  | Rate = vol of hydrogen produced / time ✓  OR  = 41 / 6 or values taken from the graph ✓  = 6.83 ✓ | |

1. Catalytic converters are fitted to a car’s exhaust system to reduce pollution caused by carbon monoxide.



|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** |  | The inside of the catalytic converter has a high surface area.  Why is this important? **[1 mark]** | |
|  |  | Speeds up the rate of the reaction by allowing more reactions to happen at the same time ✓ | |
|  |  |  |  |
| **(b)** |  | Here is the reaction that happens in the catalytic converter between carbon monoxide and oxygen.  2CO (g) + O2(g) 2CO2 (g)  The reaction is exothermic.  Draw a reaction profile to show the effect of using a catalyst on the energy involved in the reaction. **[3 marks]** | |
|  |  | Diagram: reaction that happens in the catalytic converter between carbon monoxide and oxygen.  One mark for the correct axis labels ✓  One marks for correct exothermic profile ✓  One mark for correct representation of the effect of the catalyst on the activation energy ✓ | |

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# End of topic quiz

# Topic C5: Monitoring and controlling chemical reactions

## Learner Activity

### Topic: C5 of J250

**Total marks: 40**

1. During the Haber process, hydrogen and nitrogen gas are converted into ammonia.



Here is the equation for the reaction.

H2 (g) + N2 (g)  2NH3 (g)

Iron is also added to the reaction. The iron acts as a catalyst.

How can a catalyst increase the rate of reaction? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Lowers the activation energy for the reaction to occur |  |
| **B** | Removes any excess reactants from the reaction |  |
| **C** | Raises the temperature of the reaction |  |
| **D** | Reduces the production of any unwanted chemicals |  |

Your answer

1. The sign  means that a reaction is… **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Complete |  |
| **B** | Incomplete |  |
| **C** | Irreversible |  |
| **D** | Reversible |  |

Your answer

1. Anna tests four powders to find a catalyst for the reaction of zinc with sulphuric acid.

Zn + H2SO4 🡪 ZnSO4 + H2

Here are her results.

| **Powder** | **Powder colour at start** | **Powder colour at end** | **Volume of gas made (cm3)** |
| --- | --- | --- | --- |
| **1** | orange | orange | 5 |
| **2** | green | black | 50 |
| **3** | black | black | 50 |
| **4** | blue | blue | 30 |

Which powder is the best catalyst for the reaction? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | 1 |  |
| **B** | 2 |  |
| **C** | 3 |  |
| **D** | 4 |  |

Your answer

1. Enzymes are biological catalysts, used in processes such as brewing. Yeast contains an enzyme which reacts with glucose to produce alcohol.

Which of these factors **will not** affect the rate of reaction? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Temperature |  |
| **B** | pH |  |
| **C** | Light intensity |  |
| **D** | Glucose concentration |  |

Your answer

1. A student is looking at the rate of reaction of hydrochloric acid reacting with sodium thiosulfate at different temperatures.

Here is a graph of his results.

Graph: rate of reaction of hydrochloric acid reacting with sodium thiosulfate at different temperatures

What is the trend of this graph? **[1 mark]**

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| **D** | The lower the temperature the faster reaction. |  |

Your answer

1. A student sets up apparatus to measure the volume of gas produced when marble chips are reacted with hydrochloric acid.

Which piece of apparatus would you use to measure the volume of gas produced? **[1 mark]**

|  |  |  |
| --- | --- | --- |
| **A** | Beaker |  |
| **B** | Gas syringe |  |
| **C** | Pipette |  |
| **D** | Balance |  |

Your answer

1. The equation shows the reaction of copper carbonate with hydrochloric acid.

CuCO3 (s) + 2HCl(aq) CuCl2 (aq) + H2O (l) + CO2 (g)

The rate of this reaction can be increased by various different methods.

|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** |  | Why will increasing the temperature of the reaction increase the rate? **[4 marks]** | |
|  |  |  | |
|  |  |  |  |
| **(b)** |  | Why will increasing the concentration of the reactants increase the rate? **[3 marks]** | |
|  |  |  | |
|  |  |  |  |
| **(c)** |  | Why will cutting the CuCO3 into smaller pieces increase the rate? **[3 marks]** | |
|  |  |  | |

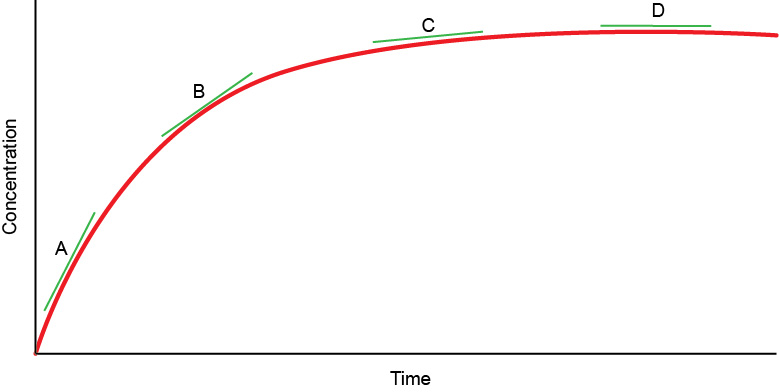
1. The Haber process is where hydrogen and nitrogen are reacted to produce ammonia.

3H2 (g) + N2(g)   2NH3(g)

The production of ammonia is an **exothermic** process.

|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** |  | This reaction is in **dynamic equilibrium**.  What is a dynamic equilibrium? **[1 mark]** | |
|  |  |  | |
|  |  |  |  |
| **(b)** | **(i)** | It has been found that if the reaction is heated too much the production of ammonia drops. Due to this, a compromise temperature of 450 oC is used.  Why does the yield of ammonia drop when the reaction is heated? **[2 marks]** | |
|  |  |  | |
|  |  |  |  |
|  | **(ii)** | Changing the pressure will also affect the yield of ammonia produced.  How and why should the pressure be changed to increase the yield? **[2 marks]** | |
|  |  |  | |
|  |  |  |  |
|  | **(iii)** | 10gof hydrogen reacts with excess nitrogen gas.  If only 28% of the hydrogen is converted into ammonia, what mass of ammonia is produced? Include units and give your answer to 3 significant figures.  **[5 marks]** | |
|  |  |  | |

1. During a chemical reaction, the change in concentration was recorded over the duration of the reaction.



|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** | **(i)** | At which part of the graph, **A**, **B** or **C**, is the rate of reaction the greatest?  **[1 mark]** | |
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|  |  |  |  |
|  | **(ii)** | What happens to the reaction at the end of the graph, **D**? **[1 mark]** | |
|  |  |  | |
|  |  |  |  |
| **(b)** |  | On the graph above, draw an additional line for a reaction using the **same quantities** of reactants, but at a lower temperature. **[2 marks]** | |
|  |  |  |  |
| **(c)** | **(i)** | A student investigates the rate of reaction for the reaction of hydrochloric acid and iron by recording the volume of hydrogen produced.  6HCl (aq) + 2Fe (s) FeCl3(aq) + H2 (g)  Here are his results.   | **Time (Mins)** | **Volume of Hydrogen (cm3)** | | --- | --- | | 0 | 0 | | 1 | 14 | | 2 | 25 | | 3 | 34 | | 4 | 36 | | 5 | 39 | | 6 | 41 | | 7 | 41 | | 8 | 41 | | 9 | 41 |   Plot a graph of the student’s results on the grid over page. **[4 marks]** | |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Graph paper** | |
|  |  |  |  |
|  | **(ii)** | Find the average rate of reaction from the data, or your graph. **[2 marks]** | |
|  |  |  | |

1. Catalytic converters are fitted to a car’s exhaust system to reduce pollution caused by carbon monoxide.



|  |  |  |  |
| --- | --- | --- | --- |
| **(a)** |  | The inside of the catalytic converter has a high surface area.  Why is this important? **[1 mark]** | |
|  |  |  | |
|  |  |  |  |
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