

Equilibria

Q1. (2018)

- 3 Which statement is true for a reversible reaction when it is at dynamic equilibrium?
- A The concentration of the products is increasing.
 - B The rate of the backward reaction is greater than the rate of the forward reaction.
 - C The rate of the forward reaction is equal to the rate of the backward reaction.
 - D The rate of the forward reaction is greater than the rate of the backward reaction.

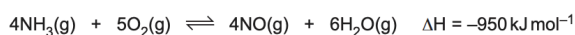
Your answer

☐

[1]

Q2. (2018)

- 7 Look at the equation for a reversible reaction.



The reversible reaction forms a dynamic equilibrium in a sealed container.

Which of the following would move the position of equilibrium to the **right**?

- A Decreasing the pressure and decreasing the temperature.
- B Increasing the pressure and decreasing the temperature.
- C Increasing the pressure and increasing the temperature.
- D Increasing the pressure and using a catalyst.

Your answer

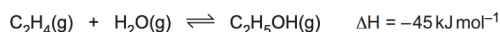
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Q3. (2018)

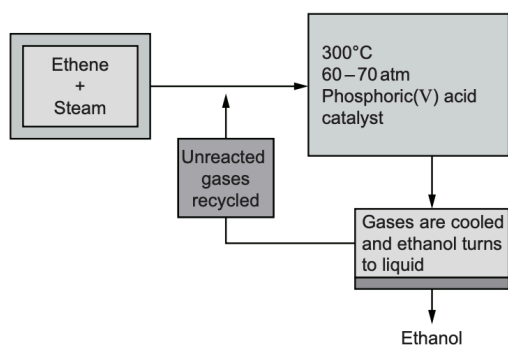
- 19* Ethanol is manufactured by reacting ethene, C_2H_4 , with steam.

The reaction is reversible and occurs in a closed system.



Only 5% of the ethene is converted into ethanol at each pass through the reactor.

By removing the ethanol from the equilibrium mixture and recycling the ethene, it is possible to achieve an overall 95% conversion.



Explain why the conditions used for the process are chosen.

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[6]

Q4. (2019)

7 Which statement describes what happens when a reaction **reaches** equilibrium?

- A The forward reaction happens at a faster rate than the backwards reaction.
- B The forward and backward reactions happen at the same rate.
- C The forward and backward reactions stop happening.
- D The backward reaction happens at a faster rate than the forward reaction.

Your answer

☐

[1]

Q5. (2019)

18 In the Haber process nitrogen gas, N_2 , reacts with hydrogen gas.

Ammonia, NH_3 , is made. The reaction is a reversible reaction.

A)

(a) Write the **balanced symbol** equation for the reaction.

..... [2]

B)

(b) The conditions used to make ammonia in the Haber process are:

- a pressure of 200 atmospheres
- a temperature of $450^\circ C$.

The reaction is an exothermic reaction.

A company making ammonia increases the temperature used to $550^\circ C$.

(i) What happens to the **rate of the reaction** when the temperature is increased?

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C)

(ii) The company thinks that the increase in temperature will increase the **yield** of ammonia.

Is the company correct? Explain your answer.

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D)

(c) The company wants to reduce the cost of making the ammonia.

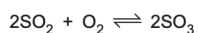
They decide to reduce the pressure used to 150 atmospheres.

Write about **two** disadvantages of using a lower pressure to make ammonia.

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Q6. (2020)

- 9 The Contact process produces sulfur trioxide, SO_3 , in an **exothermic** reaction.



The temperature in the reaction vessel is usually 450°C .

What happens as the temperature is increased to 600°C ?

- A Higher rate of reaction and increased yield of sulfur trioxide.
- B Higher rate of reaction and decreased yield of sulfur trioxide.
- C Higher rate of reaction and no change in yield of sulfur trioxide.
- D Lower rate of reaction and decreased yield of sulfur trioxide.

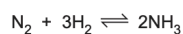
Your answer

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[1]

Q7. (2021)

- 4 What are the conditions usually used for the production of ammonia in the Haber process?



- A 200°C , 450 atmospheres pressure and an iron catalyst
- B 450°C , 2 atmospheres pressure and a vanadium(V) oxide catalyst
- C 450°C , 200 atmospheres pressure and an iron catalyst
- D 450°C , 200 atmospheres pressure and a nickel catalyst

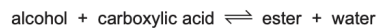
Your answer

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[1]

Q8. (2021)

- 13 An alcohol and a carboxylic acid react to form an ester and water in an equilibrium reaction.



Why is an acid catalyst used in this reaction?

- A The catalyst is changed chemically during the reaction.
- B The equilibrium concentration of the ester is increased.
- C The purity of the ester is increased.
- D The time taken to reach equilibrium is decreased.

Your answer

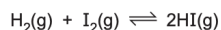
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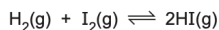
Q9. (2021) – 22b

22 A company makes hydrogen iodide, HI, gas by reacting hydrogen gas with iodine gas.

Look at the equation for the reaction.



(b) The reaction to make hydrogen iodide is an equilibrium reaction.



The forward reaction is **exothermic**.

The yield of hydrogen iodide and the rate at which the reaction reaches equilibrium are affected by different conditions.

Look at two possible reaction conditions, **A** and **B**, the company could use for this reaction.

	Temperature (°C)	Pressure (atmospheres)	Catalyst?
A	450	1	Yes
B	700	3	No

The company decides to use reaction conditions **A**, instead of **B**.

Explain why they make this choice.

Use ideas about **rate of reaction** and **position of equilibrium** to help you.

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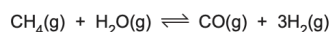
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Q10. (2022)

21 Hydrogen gas is made by the reaction between methane, CH₄, and steam.

The reaction reaches a **dynamic equilibrium**.

This is the equation for the reaction.



A)

(a) State what is meant by a **dynamic equilibrium**.

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..... [2]

B)

(b) The position of equilibrium moves if the reaction conditions are changed.

(i) The forward reaction is **endothermic**.

The **temperature** of the equilibrium mixture is **increased**.

State and explain what happens to the position of the equilibrium.

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C)

- (ii) The highest yield of hydrogen gas is made using a low pressure, such as 1 atmosphere.

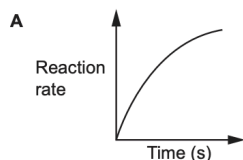
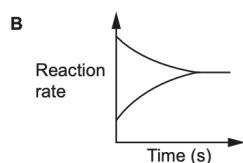
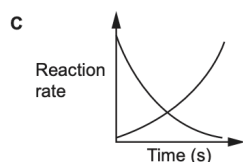
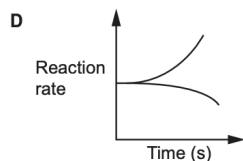
The reaction is actually carried out using a catalyst at a pressure of 30 atmospheres.

Suggest why a pressure of 30 atmospheres is used.

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Q11. (2023)

- 13 Which graph shows a dynamic equilibrium?



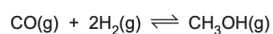
Your answer ☐

[1]

Q12. (2023)

- 21 Methanol, CH_3OH , is made in industry by reacting carbon monoxide with hydrogen.

This is the equation for the reaction.



The forward reaction is exothermic.

A)

- (a) A temperature of 250°C and a pressure of 100 atmospheres is used for the reaction.

- (i) Describe and explain the effect on the yield of methanol from using a pressure of 15 atmospheres.

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..... [3]

B)

- (ii) The yield of methanol is greater when a temperature of 150 °C is used instead of 250 °C.

Suggest why a temperature of 150 °C is **not** used in industry.

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..... [1]

C)

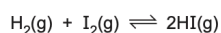
- (b) A catalyst is used to speed up the reaction.

Describe the effect on the position of equilibrium from using a catalyst.

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..... [1]

Q13. (2024)

- 12 The reaction between hydrogen, H₂, and iodine, I₂, is reversible.



The reaction is exothermic.

What will increase the yield of hydrogen iodide, HI?

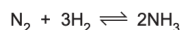
- A Adding a catalyst
B Adding less hydrogen
C Decreasing the temperature
D Increasing the pressure

Your answer ☐

[1]

Q14. (2024)

- 17 Ammonia is made in the Haber process. This is the balanced symbol equation for this process.



A)

- (a) The reversible reaction is carried out in a closed system.

- (i) State how you can tell that this reaction is **reversible**.

..... [1]

B)

- (ii) What is a **closed system**?

.....
..... [1]

C)

- (iii) If **dynamic equilibrium** is reached, which of these statements are correct?

Tick (✓) **two** boxes.

Only ammonia, NH₃, is being made.

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The amounts of reactants and products are constant.

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The forward and backward reactions are happening at the same rate.

☐

The forward reaction is faster than the backward reaction.

☐

The reaction has finished.

☐

[2]

D)

- (b) The reaction in the Haber process can be reversed by altering the reaction conditions.

The reaction can be reversed by altering the pressure.

Suggest **one other** change that could be made to the reaction conditions.

..... [1]