

1 This question is about the equilibrium reaction between hydrogen and carbon dioxide.



What effect would the following changes have on the rate of reaction and the yield of carbon monoxide?

(a) **Increase** in temperature.

(1)

	Rate	Yield of CO
<input type="checkbox"/> A	increase	increase
<input type="checkbox"/> B	increase	decrease
<input type="checkbox"/> C	increase	no change
<input type="checkbox"/> D	no change	decrease

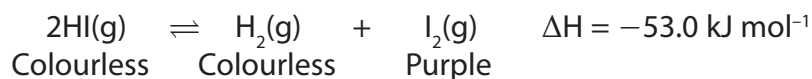
(b) **Increase** in pressure.

(1)

	Rate	Yield of CO
<input type="checkbox"/> A	increase	increase
<input type="checkbox"/> B	increase	decrease
<input type="checkbox"/> C	increase	no change
<input type="checkbox"/> D	no change	no change

(Total for Question = 2 marks)

4 The following system was allowed to reach equilibrium at 300 °C.



(a) What would you see if the equilibrium mixture was cooled to 250 °C?

(1)

- A No visible change.
- B The colour gets lighter.
- C The mixture turns colourless.
- D The mixture goes a darker purple.

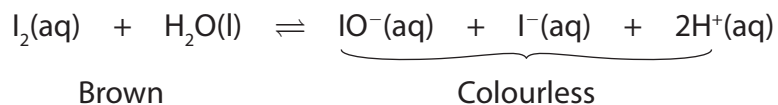
(b) The equilibrium mixture at 300 °C was compressed in a gas syringe to occupy a smaller volume. What would be seen immediately?

(1)

- A No visible change.
- B The colour gets lighter.
- C The mixture turns colourless.
- D The mixture goes a darker purple.

(Total for Question = 2 marks)

5 A solution of iodine in aqueous potassium iodide is brown. The following equilibrium exists in this solution.



What would be the effect, if any, on the colour of the solution if five drops of dilute sodium hydroxide solution were added to 5 cm³ of the iodine solution?

- A No visible change.
- B The colour gets lighter.
- C The mixture turns colourless.
- D The mixture goes a darker colour.

(Total for Question = 1 mark)

- 6 Methane hydrate is found on continental shelves deep in oceans. It forms methane in an endothermic equilibrium reaction, which may be represented as



- (a) Which of the following changes would **increase** the equilibrium yield of methane?

(1)

- A Increasing the temperature and decreasing the pressure.
- B Decreasing both the temperature and the pressure.
- C Increasing both the temperature and the pressure.
- D Decreasing the temperature and increasing the pressure.

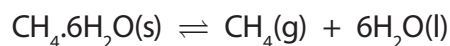
- (b) Which of the following would **decrease** the value of the equilibrium constant, K_p , for the above equilibrium?

(1)

- A Decreasing the pressure
- B Increasing the pressure
- C Decreasing the temperature
- D Increasing the temperature

(Total for Question = 2 marks)

- 7 Methane hydrate is found on continental shelves deep in oceans. It forms methane in an endothermic equilibrium reaction, which may be represented as



- (a) Which of the following changes would **decrease** the equilibrium yield of methane?

(1)

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

- (b) Which of the following would **increase** the value of the equilibrium constant, K_p , for the above equilibrium?

(1)

- A Decreasing the pressure
- B Increasing the pressure
- C Decreasing the temperature
- D Increasing the temperature

(Total for Question = 2 marks)

8 Which of the following **cannot** alter the position of a chemical equilibrium?

- A Increasing the amount of catalyst
- B Increasing the reactant concentration
- C Increasing the temperature
- D Increasing the total pressure

(Total for Question = 1 mark)

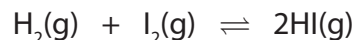
9 $\text{CO(g)} + 2\text{H}_2\text{(g)} \rightleftharpoons \text{CH}_3\text{OH(g)}$ $\Delta H = -91 \text{ kJ mol}^{-1}$

The conditions which would produce the greatest yield of methanol are

- A high pressure and high temperature.
- B high pressure and low temperature.
- C low pressure and low temperature.
- D low pressure and high temperature.

(Total for Question = 1 mark)

10 (a) For the equilibrium reaction between hydrogen and iodine

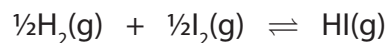


increasing the pressure of the system

(1)

- A** has no effect on the rate or the position of equilibrium.
- B** increases the rate but does not affect the position of equilibrium.
- C** increases the rate and shifts the equilibrium to the right.
- D** increases the rate and shifts the equilibrium to the left.

(b) The equation for the equilibrium reaction between hydrogen and iodine may also be written as



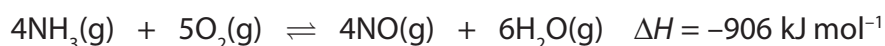
This change to the equation, compared to that in part (a),

(1)

- A** has no effect on the value of the equilibrium constant.
- B** halves the value of the equilibrium constant.
- C** doubles the value of the equilibrium constant.
- D** square roots the value of the equilibrium constant.

(Total for Question = 2 marks)

11 The first stage in the manufacture of nitric acid is the oxidation of ammonia:



(a) In modern industrial plants this reaction is carried out at a pressure of around 3 atm. Which of the following statements is **incorrect**? The raised pressure (1)

- A helps push the reactants through the reactor.
- B shifts the position of equilibrium to the right.
- C increases the cost of the reactor.
- D increases the energy cost of this part of the process.

(b) A platinum-rhodium alloy catalyst is used in this reaction. Which of the following statements is **incorrect**? The catalyst (1)

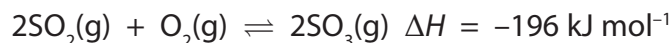
- A lowers the activation energy of the reaction.
- B has no effect on the equilibrium constant for the reaction.
- C alters the enthalpy change of the reaction.
- D reduces the energy cost of this part of the process.

(c) The operating temperature of this reaction is about 900 °C. The use of a high temperature (1)

- A increases the rate of the reaction and the equilibrium yield.
- B increases the rate of the reaction and decreases the equilibrium yield.
- C decreases the rate of the reaction and the equilibrium yield.
- D decreases the rate of the reaction and increases the equilibrium yield.

(Total for Question = 3 marks)

12 An important step in the production of sulfuric acid is the oxidation of sulfur dioxide.

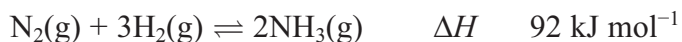


Which of the conditions below is best suited to produce a high yield of sulfur trioxide, SO_3 ?

- A 1 atm pressure and 800 °C.
- B 2 atm pressure and 800 °C.
- C 1 atm pressure and 400 °C.
- D 2 atm pressure and 400 °C.

(Total for Question = 1 mark)

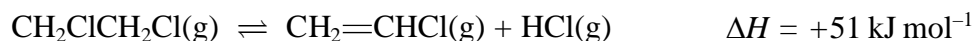
13 Which of these will **not** improve the **overall** yield of the Haber process?



- A Increasing the pressure.
- B Liquefying then removing the ammonia from the reaction.
- C Increasing the temperature.
- D Recycling unreacted nitrogen and hydrogen.

(Total for Question = 1 mark)

14 1,2-dichloroethane decomposes in the presence of a catalyst.

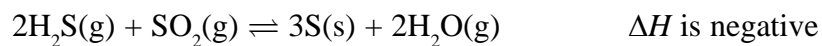


Which of the following would result in an increase in the equilibrium yield of chloroethene?

- A Increasing the temperature.
- B Increasing the pressure.
- C Increasing the surface area of the catalyst.
- D Changing the catalyst to a more efficient one.

(Total for Question = 1 mark)

15 In the equilibrium below, what effect would the changes described have on the system?



(a) Increase in temperature

(1)

- A increase rate, decrease yield
- B increase rate, increase yield
- C decrease rate, decrease yield
- D decrease rate, increase yield

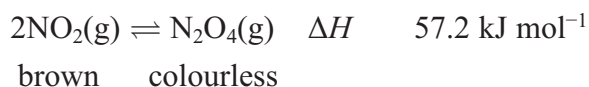
(b) Decrease in pressure

(1)

- A increase rate, decrease yield
- B increase rate, increase yield
- C decrease rate, decrease yield
- D decrease rate, increase yield

(Total for Question = 2 marks)

16 Brown nitrogen dioxide, NO_2 , exists in equilibrium with colourless dinitrogen tetroxide, N_2O_4 .



(a) The **pressure** is increased. When equilibrium is restored, the appearance of the mixture of gases will be

(1)

- A colourless.
- B unchanged.
- C paler brown.
- D darker brown.

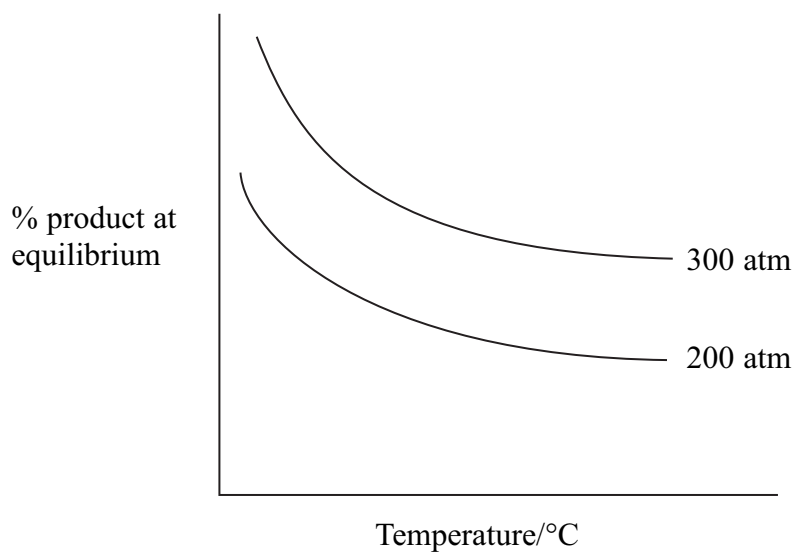
(b) The **temperature** is increased. When equilibrium is restored, the appearance of the mixture of gases will be

(1)

- A colourless.
- B unchanged.
- C paler brown.
- D darker brown.

(Total for Question 2 marks)

- 17 The graph below shows the yield of product in a gaseous equilibrium at different temperatures and pressures.



The forward reaction in the equilibrium is

- A exothermic, and the number of moles of gas is increasing.
- B endothermic, and the number of moles of gas is increasing.
- C exothermic, and the number of moles of gas is decreasing.
- D endothermic, and the number of moles of gas is decreasing.

(Total for Question 1 mark)