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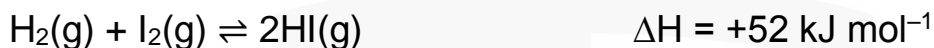
PHYSICAL CHEMISTRY

Level & Board	AQA (A-LEVEL)
TOPIC:	CHEMICAL EQUILIBRIA
PAPER TYPE:	QUESTION PAPER - 3
TOTAL QUESTIONS	10
TOTAL MARKS	37

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Chemical Equilibria - 3

1. The reaction between hydrogen and iodine can be represented by the following equation:



- (a) Write a K_c expression for the decomposition of hydrogen iodide. At a given temperature, the value of K_c for this reaction is 20.

What will be the value of K_c for the reaction between hydrogen and iodine at this temperature?

(2)

- (b) The pressure of an equilibrium mixture of hydrogen iodide, hydrogen and iodine was increased.

State what, if anything, would happen to the rates of both forward and reverse reactions.

The position of equilibrium

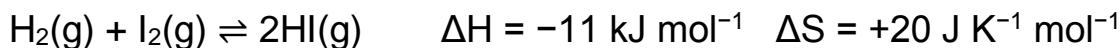
The value of the equilibrium constant.

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I am Sorry !!!!!

(4)

2. Refer to the following reaction



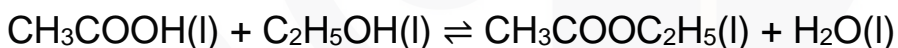
Which one of the following statements is correct?

- A. This is a redox reaction.
- B. The reaction is not feasible below 298 K
- C. At equilibrium, the yield of hydrogen iodide is changed by increasing the pressure.
- D. At equilibrium, the yield of hydrogen iodide increases as the temperature is increased.

(Total 1 mark)

3. Ethanoic acid reacts with ethanol in a reversible reaction represented by the equation below.

In an experiment 3.0 mol of ethanoic acid were mixed with 1.0 mol of ethanol and when the reaction had reached equilibrium 0.9 mol of water had been formed.

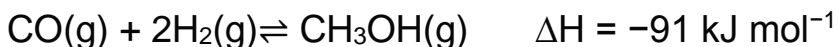


The equilibrium constant for the reaction under these conditions is

- A. 0.20
- B. 0.23
- C. 3.9
- D. 4.3

(Total 1 mark)

4. Methanol is synthesised from carbon monoxide and hydrogen according to the equation below.



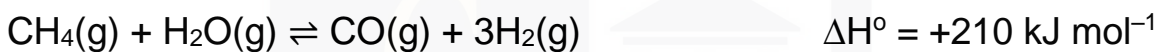
Which one of the following changes would not affect the value of the equilibrium constant and would not increase the yield of methanol?

- A. increase in temperature
- B. decrease in temperature
- C. increase in pressure
- D. decrease in pressure

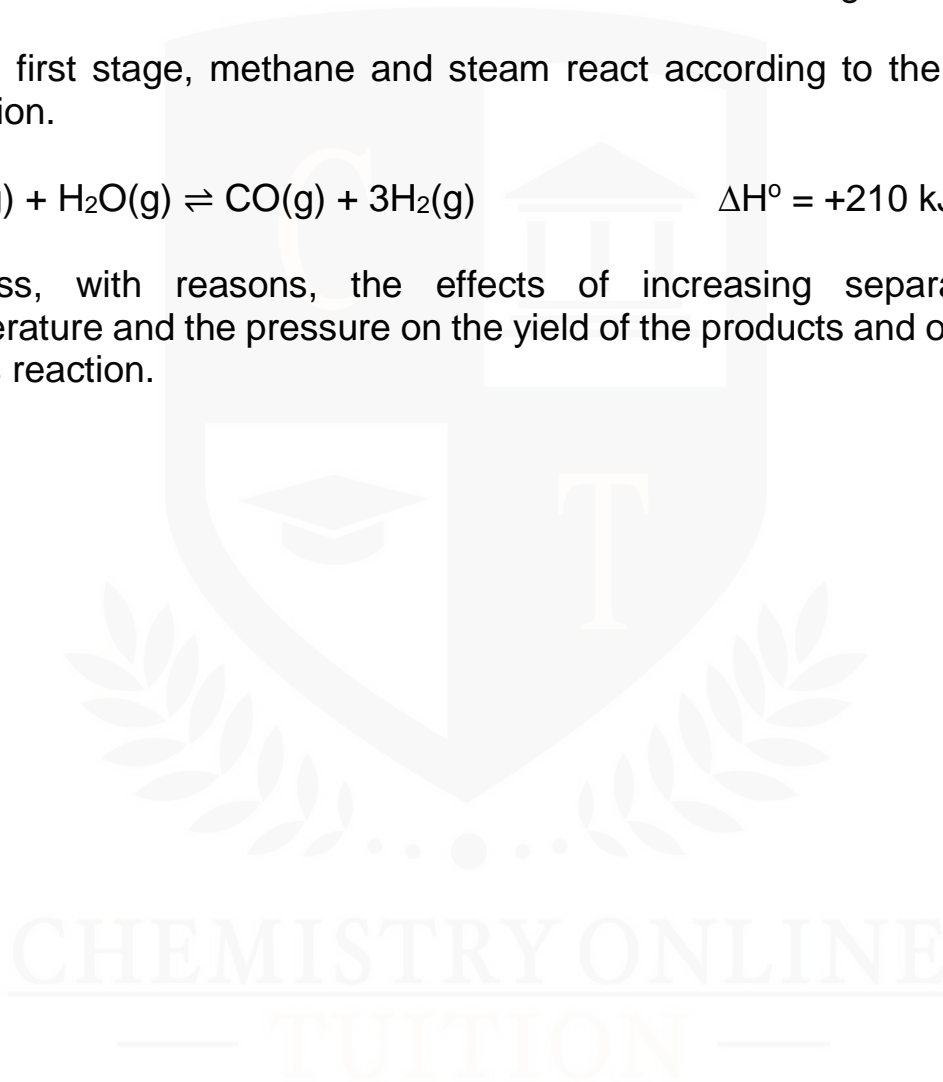
(Total 1 mark)

5. The manufacture of methanol can be achieved in two stages.

In the first stage, methane and steam react according to the following equation.



Discuss, with reasons, the effects of increasing separately the temperature and the pressure on the yield of the products and on the rate of this reaction.



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(6)

6. Use the information about the following solutions to answer the question below.

Solution F:

This is a mixture of 1 mol of propanoic acid, 1 mol of methanol and 2 mol of water.

Solution G:

This was originally the same mixture as solution F but it has been left to reach equilibrium.

Compared to the pH of solution F, the pH of solution G will be.

- A. Considerably lower
- B. Slightly lower
- C. Slightly higher
- D. Exactly the same.

(Total 1 mark)

7. As a first step in the manufacture of nitric acid it has been suggested that nitrogen monoxide, NO, can be formed from nitrogen and oxygen in a reversible reaction.

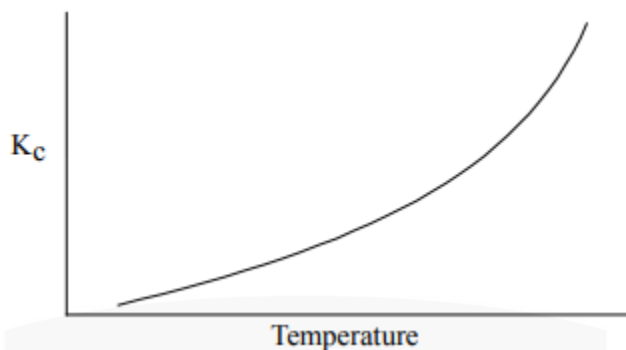
(a) Write an equation for this reaction and deduce an expression for the equilibrium.

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(2)

(b) The sketch graph below shows how the value of K_c for this reaction changes with temperature.

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Use this graph to deduce whether the reaction is exothermic or endothermic. Explain your answer.

(2)

(c) The value of K_c for this reaction is 1×10^{-5} at 1500 K.

Explain the significance of this value for an industrial chemist interested in manufacturing nitrogen monoxide by the direct combination of the elements.

(2)

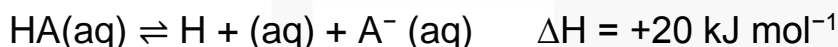
(d) When cooled, nitrogen monoxide reacts with oxygen to form gaseous nitrogen dioxide, NO_2 , in a reversible reaction.

Write an equation for this reaction.

State how an increase in pressure would change the position of the equilibrium and the value of the equilibrium constant for this reaction.

(3)

8. A weak acid HA dissociates in aqueous solution as shown below



Which one of the following changes will result in a decrease in the pH of an aqueous solution of the acid?

- A. addition of a little aqueous sodium hydroxide solution
- B. raising the temperature of the solution
- C. dissolving a little of the sodium salt, NaA, in the solution
- D. adding a platinum catalyst to the solution

(Total 1 mark)

9. A fixed mass of marble is reacted with dilute hydrochloric acid at a constant temperature.

Explain why the rate of the reaction is increased if the lumps of marble are reduced in size.

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(2)

10. When ammonia gas is heated, a homogeneous, dynamic equilibrium is established between ammonia and its constituent elements. This decomposition is endothermic.

(a) Explain the terms homogeneous, dynamic and equilibrium.

Write an equation for this decomposition and derive an expression for the equilibrium constant, K_c

(5)

(b) State and explain the conditions under which a high equilibrium concentration of hydrogen would be obtained.

(4)



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