Equilibria (F)

1. Look at the equation for the Haber process.

$N_{27} + 3H_2 \leftrightharpoons 2NH_3$

What is meant by the symbol $\leftrightharpoons$ in the equation?

A A reaction that involves a catalyst.
B A reaction that is exothermic.
C A reaction with 100% atom economy.
D A reversible reaction.

Your answer ☐ **[1]**

2. The Haber process is used to make ammonia, NH_3.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

The reaction reaches a **dynamic equilibrium**.

i. What happens to the **rate** of the forward and backward reactions at dynamic equilibrium?

_____ **[1]**

ii. What happens to the **concentrations** of the reacting substances at equilibrium?

_____ **[1]**

3 (a). The reversible reaction between carbon dioxide and hydrogen makes methane and water.

carbon dioxide + hydrogen ⇌ methane + water

In a sealed container this reversible reaction forms a **dynamic equilibrium**.

What is meant by the term dynamic equilibrium?

Refer to both concentration and rate of reaction in your answer.

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_____

_____

_____ **[2]**

(b). * Kayvan investigates the effect of changing the pressure and changing the temperature on this reaction.

carbon dioxide + hydrogen ⇌ methane + water

The table shows the percentage yield of methane in the equilibrium mixture under different conditions.

		Pressure in atmospheres			
		100	**200**	**300**	**400**
Temperature in °C	**300**	35%	52%	65%	80%
	600	30%	46%	58%	74%
	900	23%	37%	47%	62%
	1200	14%	25%	36%	48%

Describe what happens to the percentage yield as the pressure and temperature change and explain the effect of increasing the pressure on the rate of reaction.

[6]

END OF QUESTION PAPER