Year 12 Chemistry – Equilibrium Practice Problems

[22 marks]

Name:_____

Question 1

(1 mark)

Consider the following endothermic reaction for the production of hydrogen gas in a rigid container:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3\,H_2(g)$$

Which of the following would increase the **Final yield** of hydrogen gas?

(a) adding a catalyst

(b) adding inert argon gas

(c) increasing the pressure

(d) increasing the temperature

Question 2

A syringe full of nitrogen dioxide is compressed by a student to the point where no more compression is physically possible. What will the student observe and why? Write a chemical reaction that describes the observation

[3 marks]

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Question 3

The following equilibrium is being investigated:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3\,H_2(g) \qquad \Delta H = +200\ kJ$$

Four identical sealed boxes are set up at 300°C and 1.00 atm, each containing the equilibrium mixture. Each of the boxes is treated as described below, and time allowed for a new equilibrium to be established. In each case describe the change between the original equilibrium and the new equilibrium.

	What happens to the total pressure? Write 'increase', 'decrease' or 'no change'.	What happens to the partial pressure of CO? Write 'increase', 'decrease' or 'no change'.	What happens to the equilibrium position? Write 'move to the right', 'move to the left' or 'no change'.
The system is heated above 300°C.			
More $CH_4(g)$ (at 300°C) is injected into the box.			
Ne(g) (at 300°C) is injected into the box.			
The volume of the box is halved.			

[8 marks]

Question 4

Write the equilibrium constant expression for each of the following:

Equation	$Fe(H_2O)_5NCS^{2+}(aq) + H_2O(\ell) \rightleftharpoons Fe(H_2O)_6^{3+}(aq) + NCS^-(aq)$
Equilibrium constant expression	

Equation	$2\ NOC\ell(g) \rightleftharpoons 2\ NO(g) + C\ell_2(g)$
Equilibrium constant expression	

[4 marks]

Question 5

Hydrogen, which is used for the synthesis of ammonia, is sometimes made from the reaction

$$CH_4(g) + H_2O(g) \underset{1030\ K}{\overset{Ni\ catalyst}{\rightleftharpoons}} CO(g) + 3H_2(g);\ \Delta H = 206\ kJ\ mol^{-1}$$

In a research laboratory, some methane and water are added to a 1000 cm^3 reaction vessel and equilibrium is established.

a. More CO(g) at 1030 K is added. As a result, the temperature in the reaction vessel should

rise **fall** **remain constant**

Circle the correct response above **and** explain your answer in the space below.

(2 marks)

b. The total pressure on the reacting system is increased by decreasing the volume of the reaction vessel. As a result the yield of hydrogen would

increase **decrease** **remain constant**

Circle the correct response **and** explain your answer in the space below.

(2 marks)

c. The total pressure on the reacting system is increased by adding argon (an inert gas) to the reaction vessel without changing its volume. As a result the yield of hydrogen would

increase **decrease** **remain constant**

Circle the correct response **and** explain your answer in the space below.

(2 marks)