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Student Number

NORTH SYDNEY GIRLS HIGH SCHOOL



2021-22 HSC Assessment Task 1

Chemistry

General Instructions

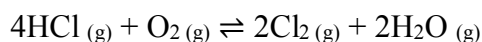
- Reading Time – 5 minutes
- Working Time – 55 minutes
- Write using a black pen
- Draw diagrams using pencil
- NESA calculators may be used
- Show all relevant working in questions involving calculations.
- **Write your student number at the top of this booklet**
- **Write your answers in the space provided.**

Total Marks – 30

Weighting – 20 %

Question 1 (4 marks)

Consider the following reaction:



When the temperature of this system is increased, the position of equilibrium shifts to increase the concentration of HCl.

- a) What would be the effect on the concentration of HCl in this system if an inert gas was added to the reaction vessel? 1

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- b) Justify TWO additional changes that could be made to cause this system to favour the reverse reaction. 3

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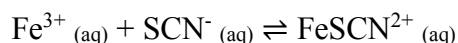
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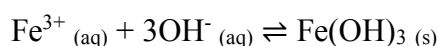
Question 2 (5 marks)

Consider the two equilibrium processes shown below.

Equilibrium 1:



Equilibrium 2:



A reaction mixture was made by mixing aqueous iron(III) nitrate and aqueous potassium thiocyanate. Aqueous iron(III) nitrate is pale yellow and aqueous potassium thiocyanate is colourless. When the two solutions are mixed, a dynamic equilibrium is reached and a red solution forms.

- a) Describe the concept of dynamic equilibrium. 2

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b) When several drops of highly concentrated hydroxide solution were added to the mixture, the solution became less red. Explain this observation using Le Chatelier's principle. **3**

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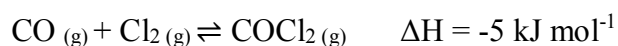
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QUESTION 3 BEGINS ON THE NEXT PAGE

Question 3 (6 marks)

Consider the following system involving carbon monoxide, chlorine and carbon oxychloride.



3.0 moles of CO and 5.5 moles of Cl_2 are placed in a 10 L vessel at 200 °C. At equilibrium, 1.5 moles of CO remain in the vessel.

- a) Calculate the value of the equilibrium constant for this reaction.

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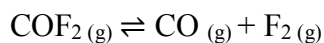
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- b) Using your understanding of collision theory, explain the effect on the equilibrium constant if the temperature of the system is lowered. 4

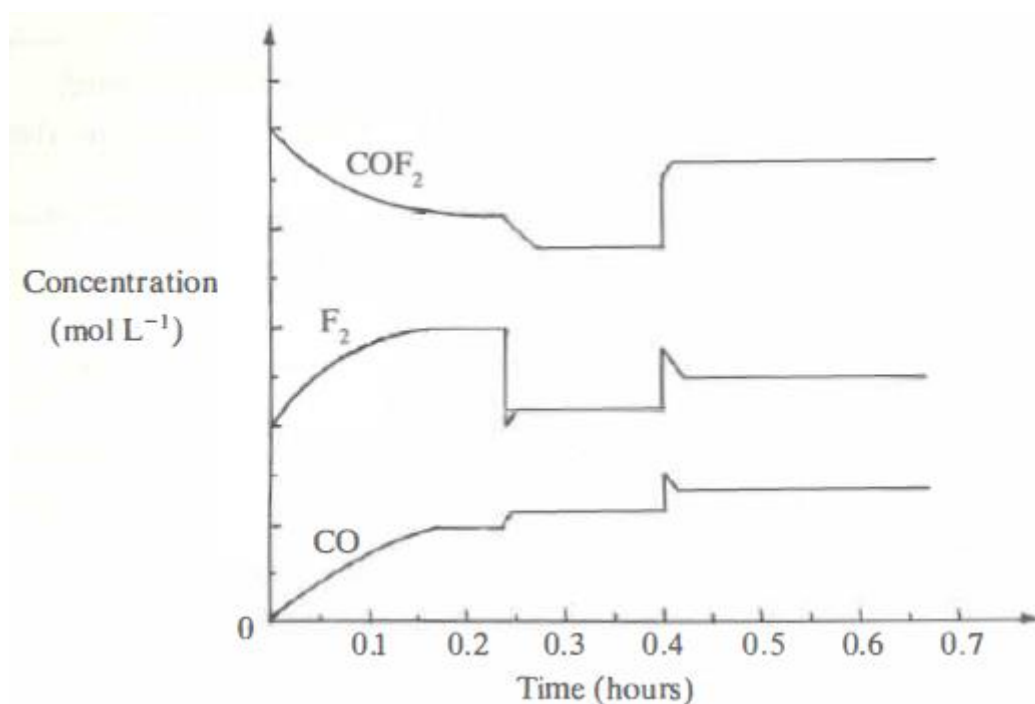
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Question 4 (4 marks)

A system is set up to observe the equilibrium between carbon monoxide, fluorine and carbon oxyfluorine. Carbon oxyfluorine decomposes according to the following equation:



Some changes were made over a period of time to a vessel containing these chemical species. The concentrations of the three gases were measured and are shown below.



a) Complete the following statements by circling the correct phrase.

2

- The value of K_{eq} at the first equilibrium position is **higher / lower / equal to** the value of K_{eq} at the third equilibrium position.
- The value of Q at $t = 0.1$ hours is **higher / lower / equal to** the value of K_{eq} at the first equilibrium position.

b) Describe what occurred between 0.4 and 0.6 hours.

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Question 5 (11 marks)

Copper(II) phosphate, $\text{Cu}_3(\text{PO}_4)_2$, is a sparingly soluble salt. K_2SO_4 and CuSO_4 are both highly soluble salts.

- a) Write the equation for the dissociation of copper(II) phosphate in water. **1**

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- b) Calculate the molar solubility of copper(II) phosphate in:

- i) 0.100 mol L⁻¹ K₂SO₄ solution. **3**

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- ii) $0.100 \text{ mol L}^{-1} \text{ CuSO}_4$ solution. **2**

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- c) Use the ionic product to determine whether a precipitate will form when 2.35×10^{-6} g of copper(II) phosphate is added to 1.500×10^3 L of solution in b i) and b ii) above. 5

[illegible]

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