Parramatta Campus:
Level 3, 1-3 Fitzwilliam St
Fairfield Main Campus:
39 Barbara St

NGO & SONS
ACADEMIC COACHING

CHEMISTRY
MOD 5 EXAM

Name: _____

Class:

Exam information:

- Working time – 2 hours
- 12 marks - Multiple Choice questions to be answered on separate answer sheet
- 49 marks – Short Answer questions to be answered on exam paper
- Pen must be used in short answers.
- Pencil may be used for diagrams.
- Allowed material: pen, pencil, rubber, ruler, calculator, given material

Total Marks – 61

This exam has two sections:

Multiple Choice

- Questions 1-12
- 12 Marks

Short Answers

- Questions 13-21
- 49 Marks

MCQ	/12
SA	/49
Total Marks	/61

Do NOT turn the page unless instructed

CHEMISTRY

Year 12 – MOD 5

MCQ (12 Marks)

1 In an esterification reaction, alcohol and acid is used to produce an ester (Alkyl Alkanoate) with an equilibrium constant value of 1.03×10^{-2}, ethanol, propanoic acid, and ethyl propanoate was present in concentrations of 0.97 M, 0.88 M, and 0.06 M, respectively (1:1:1 ratio).
How does the value of the equilibrium constant compare to the reaction quotient, and which chemical reaction direction is favoured?

A. $Q > K_{eq}$, forward

B. $Q > K_{eq}$, reverse

C. $Q < K_{eq}$, forward

D. $Q < K_{eq}$, reverse

2 The standard enthalpies and entropies of solution of calcium fluoride and ammonium fluoride are tabulated below.

	Calcium fluoride	*Ammonium fluoride*
$\Delta_{sol}H°$ (kJ mol^{-1})	+11.5	–1.20
$\Delta_{sol}S°$ (J mol^{-1} K^{-1})	+35.5	+54.6

Which statement correctly describes the dissolution of the two salts in water?

A. Neither salt dissolves spontaneously

B. Calcium fluoride dissolves spontaneously, ammonium fluoride does not

C. Ammonium fluoride dissolves spontaneously, calcium fluoride does not

D. Both salts will dissolve spontaneously

3 A step in the Contact process involves the synthesis of sulfur trioxide gas from oxygen and sulfur dioxide gas. This chemical system establishes equilibrium as shown in the chemical equation below.

$$2\,SO_2\,(g) + O_2\,(g) \rightleftharpoons 2\,SO_3\,(g)$$

At 450°C, equilibrium was established with 0.26 moles of sulfur dioxide gas, 0.54 moles of oxygen gas, and 0.14 moles of sulfur trioxide gas in a 5.0 L reaction vessel.
How many moles of oxygen gas should be added to the reaction vessel to increase the number of moles of sulfur trioxide gas by 0.03 moles?

A. 0.233
B. 0.285
C. 0.374
D. 0.492

SHORT ANSWER (50 Marks)

Question 17 (4 marks)

When 100mL of 0.5M Copper (II) Nitrate solution is added to 150mL of 0.8M Potassium Hydroxide solution, a precipitate is produced.

Calculate the concentrations of Copper (II) ions and Hydroxide ions remaining in the solution after precipitation occurs.

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Question 18 (12 marks)

In an experiment, 1.0mol of pure phosgene, $COCl_2$ is placed in a 3.0L flask where the following reaction takes place:

$$COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g) \qquad K_{eq} = 2.1 \times 10^{-8}$$

a) It can be assumed that, at equilibrium, the amount of unreacted $COCl_2$ is approximately equal to 1.0mol. On the basis of the data provided, explain why this assumption is justified. (2)

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b) Calculate the equilibrium concentration in mol/L of Carbon Monoxide, CO. Assume that the amount of unreacted $COCl_2$ is approximately equal to 1.0mol. (3)

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c) What is the concentration of Chlorine gas? (1)

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d) In another experiment, Carbon Monoxide and Chlorine were placed in a sealed flask and allowed to reach equilibrium. Phosgene was formed. The temperature, pressure and volume were initially the same as in part (a) above.

Given this information, what is the equilibrium constant for this reaction? (1)

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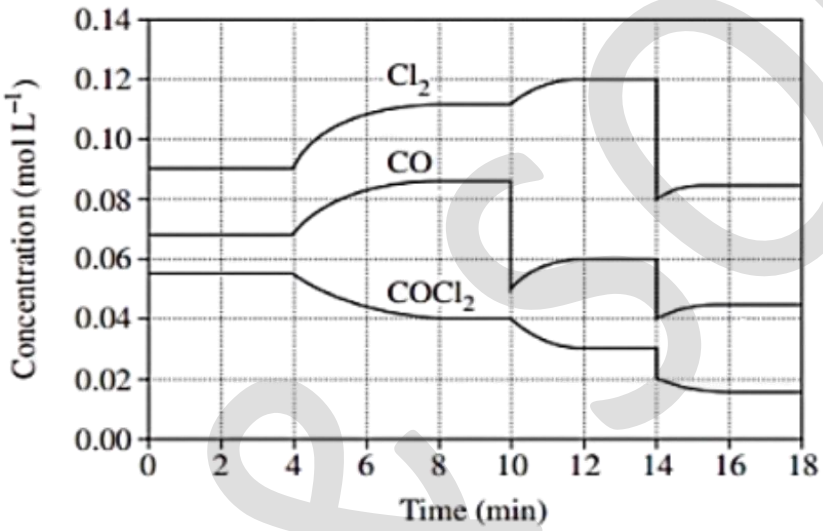
e) The graph below shows how the concentration of reactants and products vary with time. (2)

$$COCl_2(g) \rightleftharpoons Cl_2(g) + CO(g) \quad \Delta H = +108 \text{ kJ}$$



i) Identify the change applied at 10 minutes:

ii) Identify the change applied at 14 minutes:

f) Explain the reason for the change from 4-6 minutes (3)

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Question 19 (2 marks)

The oxidation of Sulfur Dioxide, SO2, to Sulfur Trioxide, SO3, can be represented by the following equation:

$$2SO2(g) + O2(g) \rightleftharpoons 2SO3(g) \qquad Keq = 1.75 \text{ at } 1000^oC$$

An equilibrium mixture has a concentration of 0.12M SO_2 and 0.16M Oxygen gas, O_2.

The temperature of the container is 1000ºC.

Find the equilibrium concentration of SO3.

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