Year 12 Chemistry Test **NAME**_____

Topic 2: Managing Chemical Processes

TOTAL MARKS: 59

1. Nickel metal acts as a catalyst in the conversion of vegetable oil into margarine.

   (a) Explain how the reaction rate is increased by this catalyst.

   _____

   _____

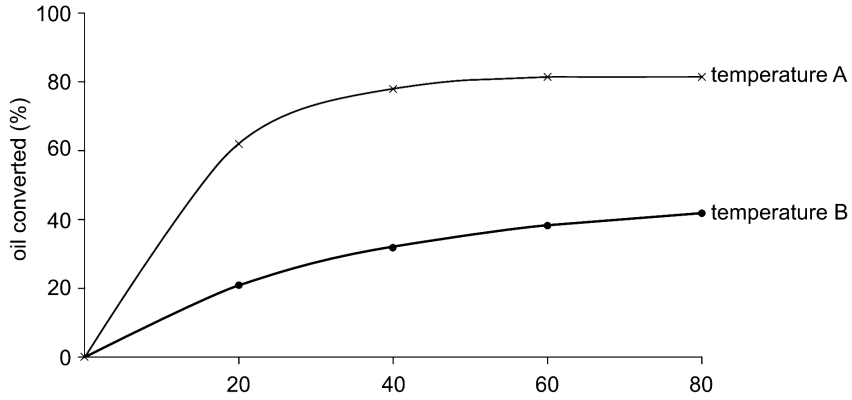
   _____

   _____

   _____

   _____ (3)

   (b) The percentage of oil converted into margarine for the catalysed reaction at two different temperatures, A and B, is shown below:



   (i) State which feature of the curves indicates that, during the first 20 minutes, the reaction occurs at a greater rate at temperatures A than it does at temperature B.

   _____ (1)

   (ii) Suggest why the curve for temperature A levels out at 60 minutes.

   _____

   _____ (1)

   (c) Margarine is produced by reaction of vegetable oil with hydrogen gas under high pressure conditions.

   Explain the effect of the high pressure on the rate of the reaction.

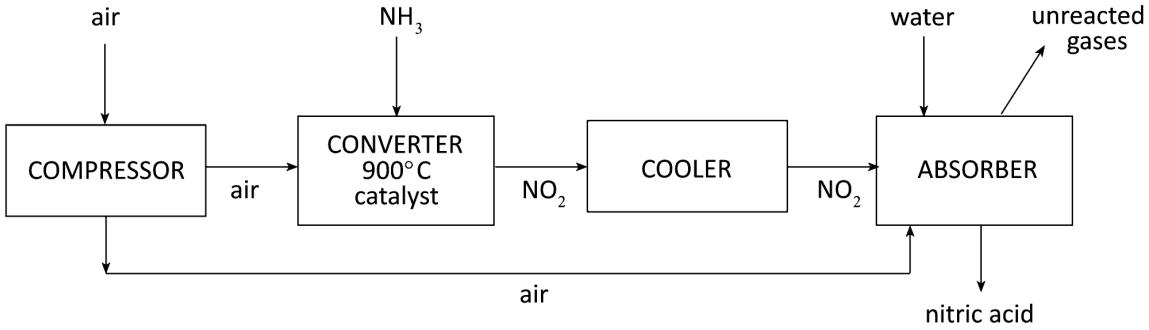
   _____

   _____

   _____

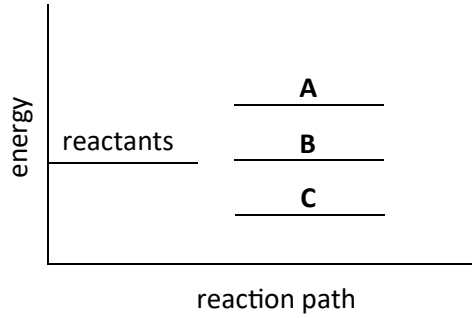
   _____ (2)

2. The production of nitric acid in a factory is summarised in the flow chart below:



(a) The production of NO_2 in the converter involves a series of chemical reactions.
The overall reaction in the converter is exothermic.

(i) The energy profile for the reaction is shown in the diagram below:



(1) State whether the products are represented by **A**, **B**, or **C**.

_____ (1)

(2) Explain why the gases in the converter need to be heated initially.

_____

_____

_____

_____ (2)

(3) Explain why heating is no longer necessary once the reaction has started.

_____

_____

_____

_____ (2)

(b)

(i) Identify from the flow chart the two raw materials that are added to the absorber to convert the NO_2 into nitric acid.

_____ (2)

(ii) Determine the oxidation state of nitrogen in NO_2.

_____ (2)

(iii) Write an equation for the conversion of NO_2 into nitric acid in the absorber.

(2)

(iv) Describe one disadvantage for the manufacturer if gases containing NO_2 are emitted from the factory.

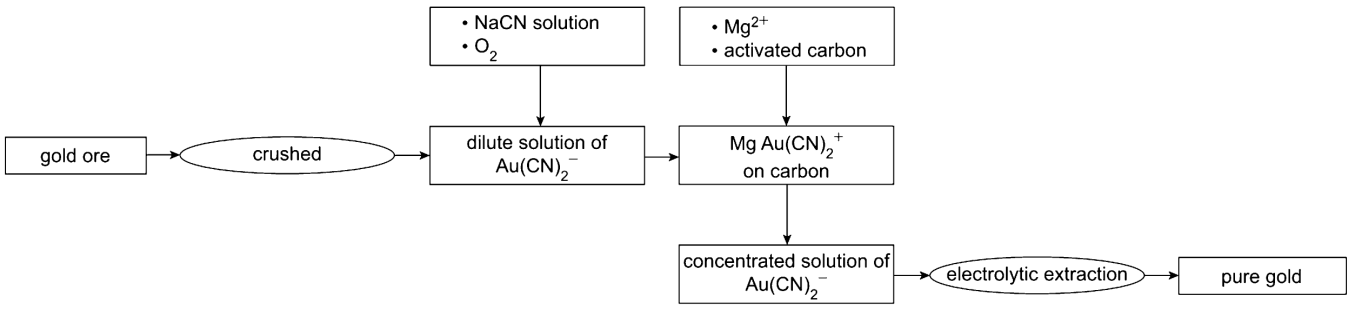
_____

_____

_____

_____ (2)

3. The extraction of gold from its ore is shown in the flow chart below:



(a) Explain the benefit of crushing the ore prior to chemical processing.

_____

_____

_____

_____ (2)

(b) The crushed ore is mixed with an NaCN solution.

Identify the other reactant added at this step.

_____ (1)

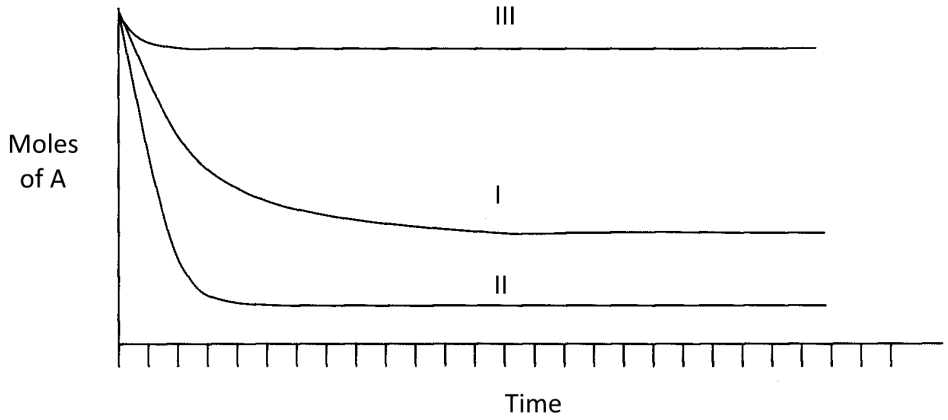
4. Chemicals A and B react to form a dynamic equilibrium mixture with chemical Z according to the equation:

$$A_{(g)} + B_{(g)} \rightleftharpoons Z_{(g)} \quad \Delta H = -101 \text{ kJ mol}^{-1}$$

(a) State what it means for the chemicals to be in dynamic equilibrium.

_____ (1)

(b) Graph I on the axes below shows the change in the moles of A, when equal moles of A and B were allowed to reach dynamic equilibrium in a closed vessel at a particular temperature and pressure. The experiment was repeated to obtain graphs II and III, in each case only changing one condition.



State and explain which graph shows the experiment which used the following different condition:

(i) A higher temperature

_____

_____

_____

_____

_____

_____ (3)

(ii) A higher pressure

_____

_____

_____

_____

_____

_____ (3)

5. An experiment was conducted to investigate the following exothermic reaction that occurs in the stratosphere:

$$Cl_{2\,(g)} + 2NO_{(g)} \rightleftharpoons 2NOCl_{(g)}$$

(a) In one trial, 1.000 mol of NOCl was added to an empty 2.00 L flask. At equilibrium 0.056 mol of Cl_2 were present.

Calculate the equilibrium concentrations of Cl_2, NO, and NOCl, in mol L^{-1} .

(4)

(b) In a second trial, under different conditions, the concentrations of the three species in equilibrium were as shown in the table below:

Species	*Concentration (mol L^{-1})*
Cl_2	0.024
NO	0.048
NOCl	0.354

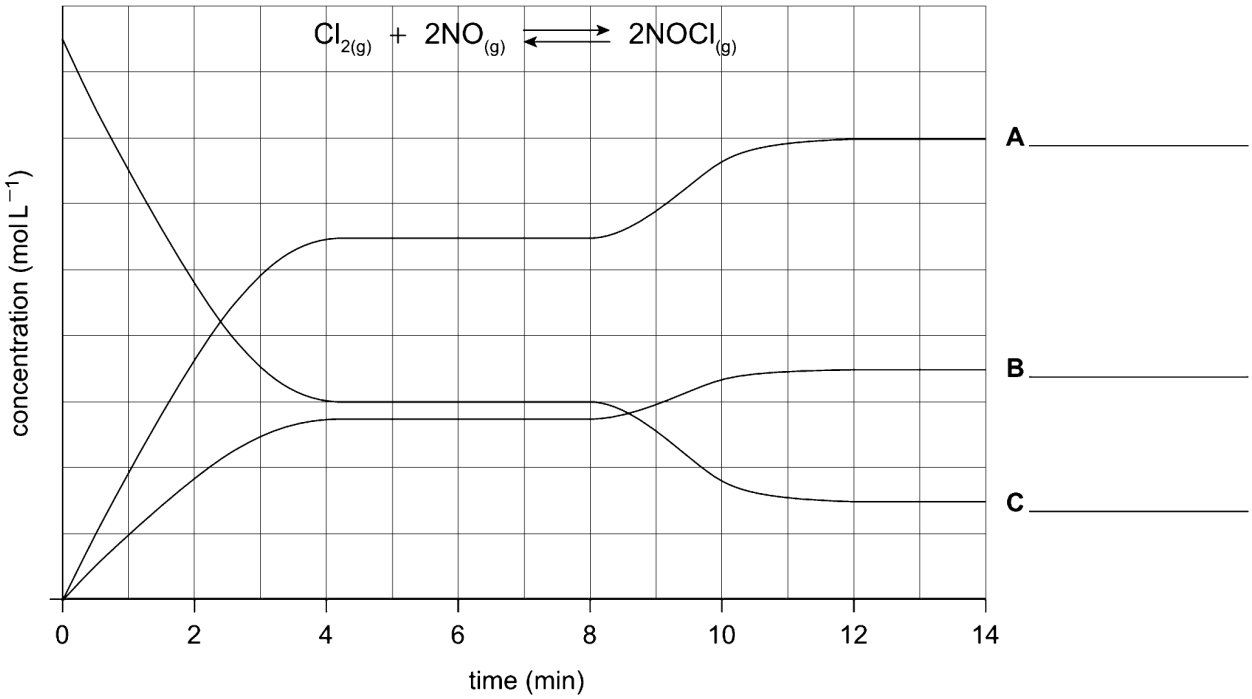
(i) Calculate the equilibrium constant for this reaction.

(2)

(ii) State the effect of an increase in temperature on the value of the equilibrium constant.

_____ (1)

(c) A third trial was conducted. The following graph shows the changes in concentration of the three species over time:



(i) On the graph above, identify A, B, and C as Cl_2, NO, or NOCl. (2)

(ii) Identify and explain the change that was made to the reaction conditions at 8 minutes.

_____

_____

_____

_____

_____

_____ (3)

6. Consider the equilibrium mixture below:

$$2SO_{2\,(g)} + O_{2(g)} \rightleftharpoons 2SO_{3\,(g)}$$

(a) Write the equilibrium expression for the reaction.

(1)

(b) The K_C values for this reaction at two different temperatures are shown in the table below:

Temperature (°C)	K_c
25	3.08
127	0.260

(i) State the effect of increasing the temperature on the yield of SO_3.

_____ (1)

(ii) Explain how the information in the table above shows that the forward reaction is exothermic.

_____

_____

_____

_____

_____ (3)

(c) One reaction at 127°C in a 0.500 L vessel was allowed to reach equilibrium. There was measured to be 0.215 moles of SO_2 and 0.599 moles of O_2 at equilibrium.

Calculate the number of moles of SO_3 at equilibrium in this reaction.

(4)

Credit will be given for answers to part (d) which correctly use appropriate chemical terms and effectively communicate knowledge and understanding of chemistry.

Your answer should be confined to the space provided.

(d) Selecting an appropriate pressure for this process is an important consideration for manufacturers.

Explain two advantages to manufacturers of using a high pressure, but suggest why manufacturers may decide to use a moderate pressure instead.

(8)