Practice Question Set For A-Level
Subject : Chemistry
Paper-1 Topic: Physical 1

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Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

Nitrogen dioxide decomposes at a high temperature.

$$2\ NO_2(g) \rightleftharpoons 2\ NO(g) + O_2(g) \qquad \Delta H = +113\ kJ\ mol^{-1}$$

(a) A 0.317 mol sample of nitrogen dioxide is placed in a sealed flask and heated at a constant temperature until equilibrium is reached.

At equilibrium, the flask contains 0.120 mol of oxygen.

Calculate the mole fraction of each substance at equilibrium.

Mole fraction of NO_2 _____

Mole fraction of NO _____

Mole fraction of O_2 _____

(3)

(b) The total pressure in the flask in part (a) is 120 kPa at equilibrium.

Calculate the partial pressure, in kPa, of NO_2

If you were unable to answer part (a) you should assume that the mole fraction of NO_2 is 0.380. This is **not** the correct answer.

Partial pressure _____ kPa

(1)

(c) The table below shows the mole fractions of the three gases in a different equilibrium mixture.

$$2\ NO_2(g) \rightleftharpoons 2\ NO(g) + O_2(g) \qquad \Delta H = +113\ kJ\ mol^{-1}$$

Gas	Mole fraction
NO_2	0.310
NO	0.460
O_2	0.230

For this equilibrium mixture, K_p = 59.7 kPa

Give an expression for K_p for this reaction.

Use your expression and the data in the table to calculate the total pressure, in kPa, in the flask.

K_p

Total pressure _____ kPa

(3)

(d) The equilibrium mixture in part (c) is compressed into a smaller volume.

Deduce the effect, if any, of this change on the equilibrium yield of oxygen and on the value of K_p

Effect on yield of oxygen _____

Effect on K_p _____

(2)

(e) The equilibrium mixture in part (c) is allowed to reach equilibrium at a lower temperature.

Explain why the equilibrium yield of oxygen decreases.

_____

_____

_____

_____

(2)
(Total 11 marks)

Q2.

When HF is added to water at 298 K, this equilibrium is established.

$$HF(aq) \rightleftharpoons H^+(aq) + F^-(aq)$$

At equilibrium, $[HF] = 7.70 \times 10^{-3}$ mol dm^{-3} and $[F^-] = 2.30 \times 10^{-3}$ mol dm^{-3}

What is the value of the equilibrium constant, in mol dm^{-3}, at 298 K?

A 1.45×10^{3} ⬭

B 3.35 ⬭

C 2.99×10^{-1} ⬭

D 6.87×10^{-4} ⬭

(Total 1 mark)

Q3.

This question is about equilibria.

(a) Give **two** features of a reaction in dynamic equilibrium.

Feature 1 _____

_____

Feature 2 _____

_____

(2)

(b) A gas-phase reaction is at equilibrium.
When the pressure is increased the yield of product decreases.

State what can be deduced about the chemical equation for this equilibrium.

_____

_____

(1)

(c) Carbon monoxide and hydrogen react to form methanol.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

0.430 mol of carbon monoxide is mixed with 0.860 mol of hydrogen.
At equilibrium, the total pressure in the flask is 250 kPa and the mixture contains 0.110 mol of methanol.

Calculate the amount, in moles, of carbon monoxide present at equilibrium.

Calculate the partial pressure, in kPa, of carbon monoxide in this equilibrium mixture.

Amount of carbon monoxide _____ mol

Partial pressure _____ kPa

(3)

(d) Give an expression for the equilibrium constant (K_p) for this reaction.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

(1)

(e) A different mixture of carbon monoxide and hydrogen is left to reach equilibrium at a temperature *T*.

Some data for this equilibrium are shown in the table below.

Partial pressure of CO	125 kPa
Partial pressure of CH_3OH	5.45 kPa
K_p	1.15×10^{-6} kPa^{-2}

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

Calculate the partial pressure, in kPa, of hydrogen in this equilibrium mixture.

Partial pressure _____ kPa

(3)

(f) Use the K_p value from the table above to calculate a value for K_p for the following reaction at temperature *T*.

$$CH_3OH(g) \rightleftharpoons CO(g) + 2H_2(g)$$

K_p _____

Units _____

(2)

(Total 12 marks)