

Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Q1.

This question is about some gas mixtures at equilibrium.

This reaction can be used to make hydrogen.



- (a) A mixture of 2.00 mol of $\text{H}_2\text{O}(\text{g})$ and 2.00 mol of $\text{CO}(\text{g})$ is allowed to reach equilibrium at a constant temperature in a 20 dm^3 container.
At equilibrium, there are 0.92 mol of $\text{H}_2(\text{g})$.

Calculate the mole fraction of $\text{H}_2(\text{g})$ in the equilibrium mixture.

Mole fraction of $\text{H}_2(\text{g})$ _____

(2)

- (b) State why the equilibrium constant (K_p) for this reaction has no units.

(1)

- (c) The temperature of the equilibrium mixture formed in part (a) is increased.

How does the amount of $\text{H}_2(\text{g})$ change when the new position of equilibrium is reached?

Tick (✓) **one** box.

The amount decreases.

☐

The amount does not change.

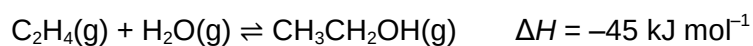
☐

The amount increases.



(1)

Ethanol can be made from ethene and steam.



The table below shows the mole fractions of each of the gases in an equilibrium mixture at 6000 kPa

Gas	Mole fraction
Ethene	0.645
Steam	0.323
Ethanol	0.0321

(d) Give an expression for K_p for this reaction.

Calculate the value of K_p at 6000 kPa

State the units.

K_p

Units _____

(4)

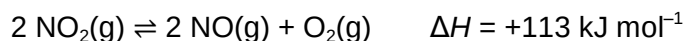
(e) State the effect, if any, of an increase in volume of the container on the value of K_p for this reaction at a constant temperature.

(1)

(Total 9 marks)

Q2.

Nitrogen dioxide decomposes at a high temperature.



- (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.

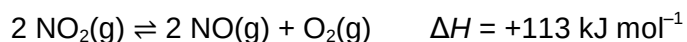
Calculate the partial pressure, in kPa, of NO_2

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.



Gas	Mole fraction
NO_2	0.310
NO	0.460
O_2	0.230

For this equilibrium mixture, $K_p = 59.7 \text{ kPa}$

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)