**Chemical Engineering Department**
**College of Engineering**
**King Saud University**

**ChE 201 – ChE Principles I**

**Time= 3 hours** **Final Examination** **25/11/1425**

Answer **ALL** questions,

**Question 1**

Two gaseous streams are mixed together to form one output stream. The first stream flows at 120 mol/min and contains $H_2$=40%, $N_2$=50% and $O_2$=10% by mole. The second stream is air (21% oxygen and 79% nitrogen by mole) and it flows at 200 g/s.

(i) **Draw** and label a flow chart for this process.

(ii) **Calculate** the molar flow rate and composition of the exit (output) stream.

**Question 2**

Propylene oxide is produced by the catalytic oxidation of propylene:

$$2C_3H_6 + O_2 \rightarrow 2C_3H_6O$$

$$2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$$

The feed to the reactor (not the fresh feed to the process) contains 3 moles of propylene per mole of oxygen. The single-pass conversion of propylene is 20%, and for every 100 moles of propylene consumed in the reactor, 90 moles of propylene oxide emerges in the reactor products. A multiple-unit process is used to separate the products: propylene and oxygen are recycled to the reactor; propylene oxide is sold as a product. and carbon dioxide and water are discarded.

Assume the reactor feed stream to be 100 mole/h as a basis of calculation.

**Calculate:**

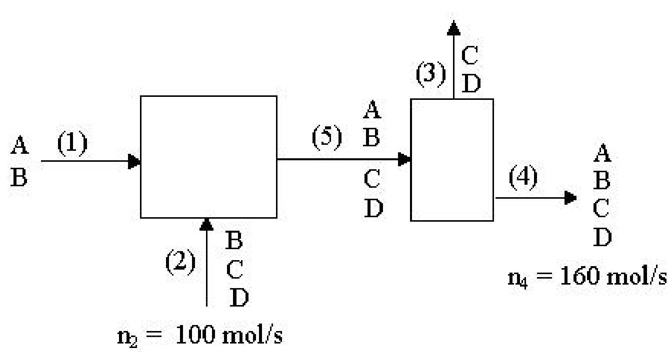
(i) the molar flow rates of propylene and oxygen in the fresh feed,

(ii) the production rate of propylene oxide.

(iii) the overall conversion of propylene.

**Question 3**

Consider the following flowchart



Two streams (1) and (2) are mixed to give a mixed stream (5) which is separated in another unit to give streams (3) and (4). The molar flow rate of stream (4) is 160 mol/s and that of stream (2) is 100 mol/s. The molar percentage are : **A** is stream (1) is 80%, **C** in stream (4) is 12.5%, **C** in stream (2) is 50%, **D** in stream (4) is 6.25% and **C** in stream (3) is 75%.

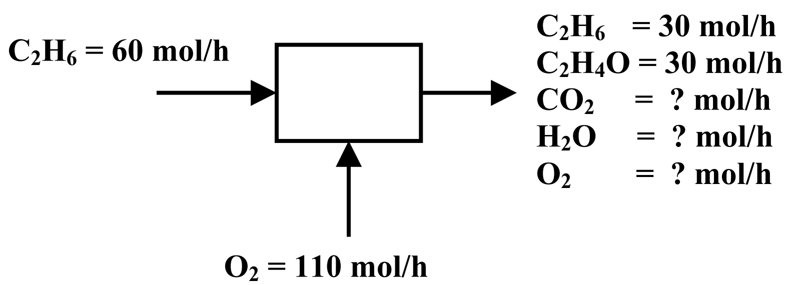
**Calculate** the molar flow rates and the compositions of all streams in the flow chart (Do NOT forget stream (5)).

## Question 4

The following reactions take place at the same time as shown in flow chart below:

$$C_2H_6 + O_2 \rightarrow C_2H_4O + H_2O$$

$$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$$




**Calculate** the percentage molar composition of the products

**DATA:** Atomic mass

C=12 H=1 O=16 N=14