Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2022/2023

| | | |
|---|---|---|
| COURSE NAME | : | PIPING AND INSTRUMENTATION DIAGRAM |
| COURSE CODE | : | BDF 30903 |
| PROGRAMME CODE | : | BDJ |
| EXAMINATION DATE | : | JULY / AUGUST 2023 |
| DURATION | : | 2 HOURS 30 MINUTES |
| INSTRUCTIONS | 1. | ANSWER **ALL** QUESTIONS |
| | 2. | THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** |
| | 3. | STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK |

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

**Q1** (a) Based on **Figure Q1 (a)**, explain the process in your own words.

(7 marks)

(b) A mixture containing 40% benzene (B) and 60% toluene (T) by mass in fed to a distillation column. An overhead steam of 90 wt% benzene is produced, and 10 wt% benzene fed to the column leaves in the bottom stream. The feed rate is 2400 kg/h. Determine the overhead flow rate and the mass flow rates of benzene and toluene in the bottom stream.

(10 marks)

(c) Each instrument should have its own unique identifying tag. Explain the identifying tag which consisting of a series of letters, as well as a number and location of instrumentation.

(4 marks)

(d) Valve is a device that regulate or control the flow of fluids. Analyse the position of the valve and justify your answer for the following situations.

(i) A valve controlling the flow of a Benzene into a storage tank.

(2 marks)

(ii) A valve controlling the flow of coolant entering an engine.

(2 marks)

**Q2** (a) Figure **Q2 (a)** shows a section of P&ID diagram.

(i) Analyse the P&ID diagram and construct the sequence to do maintenance of Valve 2 if under normal condition, Valve 1, 2 and 3 are open while Valve 4 and 5 are closed.

(6 marks)

(ii) The management decided to replace Valve 4 with another gate valve or eliminate the valve due to cost. What is your recommendation?

(3 marks)

(b) Cavitation is a common problem for centrifugal pumps. Explain how to formulate a plan to prevent that cavitation. Gives **FOUR (4)** suggestions.

(4 marks)

(c) The arrangement of pump is crucial to ensure the pumps are able to transport the fluid throughout the system. Pumps can be arranged and connected in serial or parallel. Explain both arrangements and its functions.

(6 marks)

(d) A pump-turbine system shown in **Figure Q2 (d)** draw the water from the upper reservoir in the daytime to produce power for a city. At night, it pumps water from lower reservoir to restore the situation. For a design flow rate of 3600 m3/hr in either direction, the total frictional head loss is 20 m. Assume the turbine and pump have an efficiency of 80% and 90% respectively. Density of water = 998 kg/m3. Estimate the electrical power output by the turbine in Kilowatts (kW).

(6 marks)

**Q3** (a) Based on **Figure Q3 (a)**, draw a control loop to show that PRV101 will be activated to relief pressure when the pressure in the V101 is higher than desired value.

(i) Design the diagram with PT, PIC, PY and signal line connections.

(5 marks)

(ii) Explain the conversion between electric and pneumatic signal.

(3 marks)

(b) **Figure Q3 (b)** shows an activity of adjusting the tap water temperature to 35 °C.

(i) Analyse the situation and identify the temperature control loop.

(4 marks)

(ii) Illustrate the control loop using standard symbols.

(4 marks)

(c) **Figure Q3 (c)** shows compressed gas vessel. Process variable that need to be controlled is pressure where the vessel should maintain pressure at 60 psi by using pressure controlled through both the gas flow measurement into the vessel and vessel pressure itself. Design a feedforward-plus-feedback control loop system.

(5 marks)

(d) Based on **Figure 4 (a)**, PIC-01 controls the pressure of the separator for Liquid Vapor Hydrocarbons, by mean of a split range controller with the output signal split and sent to two pressure control valves PV-A and PV-B. Examine the valve condition when the pressure increased beyond the set point.

(4 marks)

**Q4** (a) The safe operation in a safe instrument system (SIS) is composed by sensors, logic, programmers, processors and final elements designed with the purpose of causing a stop whenever safe limits are exceeded. List **FOUR (4)** of typical safe instrument system.

(4 marks)

(b) As a young engineer, you are required to take part in development of plant layout. Based on **Figure Q4 (b)**;

(i) Describe **SIX (6)** general requirements to position the equipment.

(6 marks)

(ii) Construct a possible equipment arrangement for the Feed and Reactor sub system.

(7 marks)

(c) **Figure Q4 (c)** is a process flow diagram of production of Benzene via Hydroalkylation of Toulene. Stream 6 provide feed to the reactor at 600°C. Construct a HAZOP for this stream using guideword of No and More of. Justify **TWO (2)** answers for each guideword. Refer **Table Q4 (c)** to construct your answer.

(8 marks)



**-END OF QUESTIONS-**

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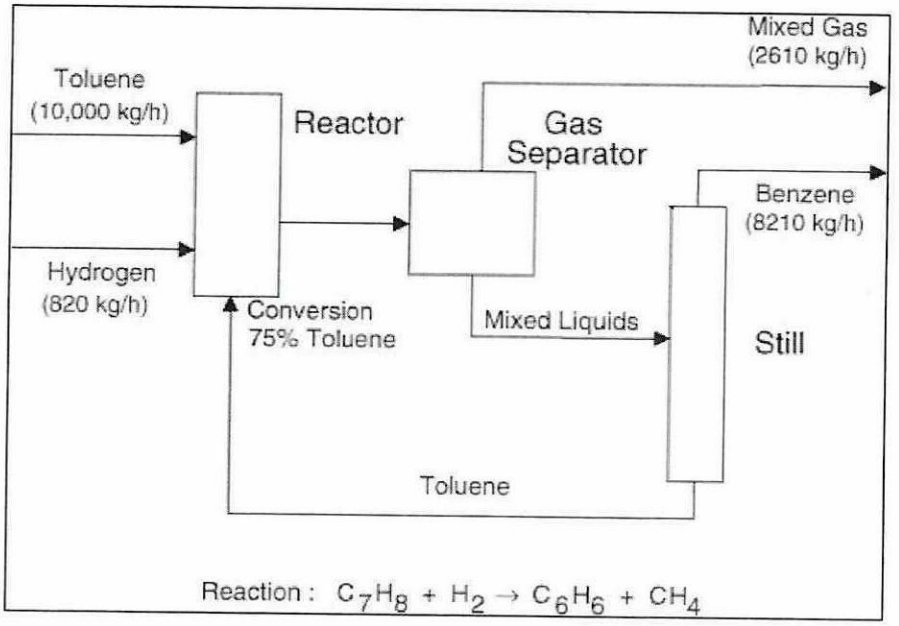


**Figure Q1 (a)**

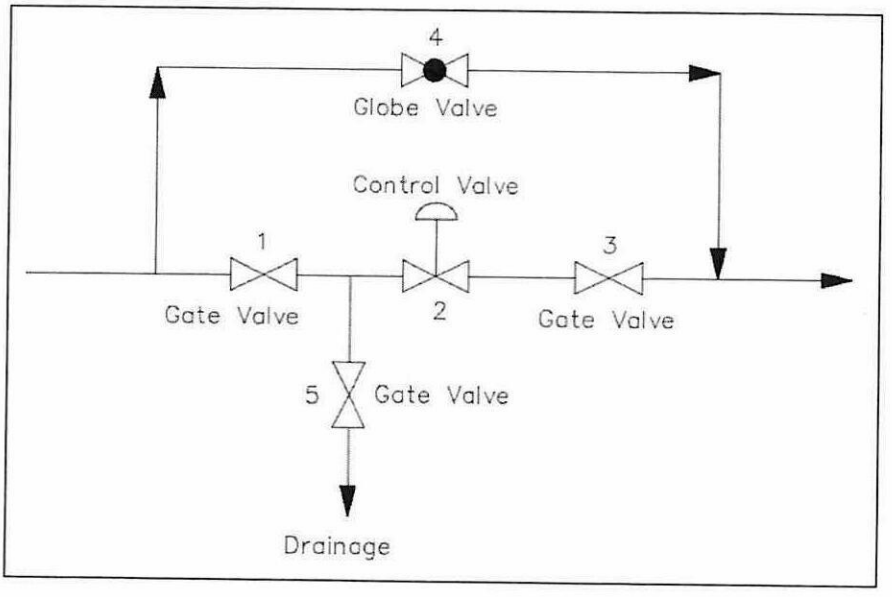


**Figure Q2 (a)**

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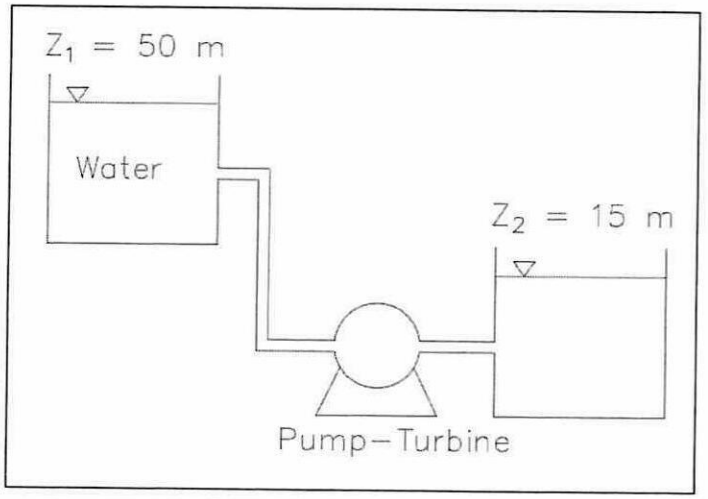


**Figure Q2 (d)**

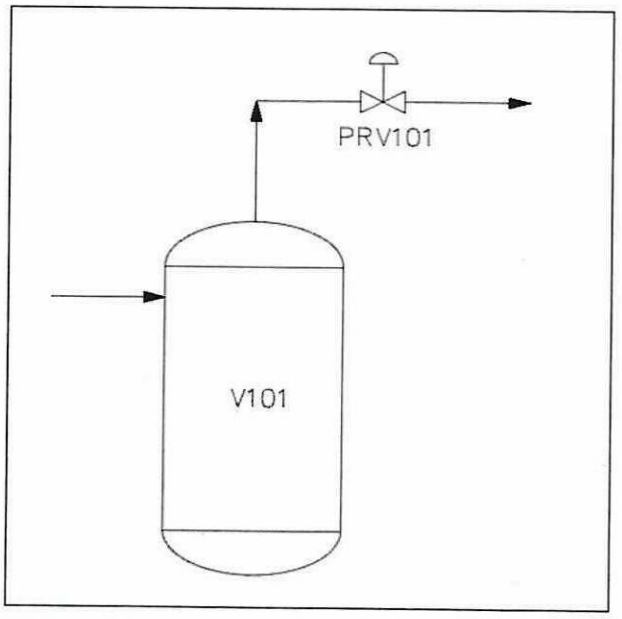


**Figure Q3 (a)**

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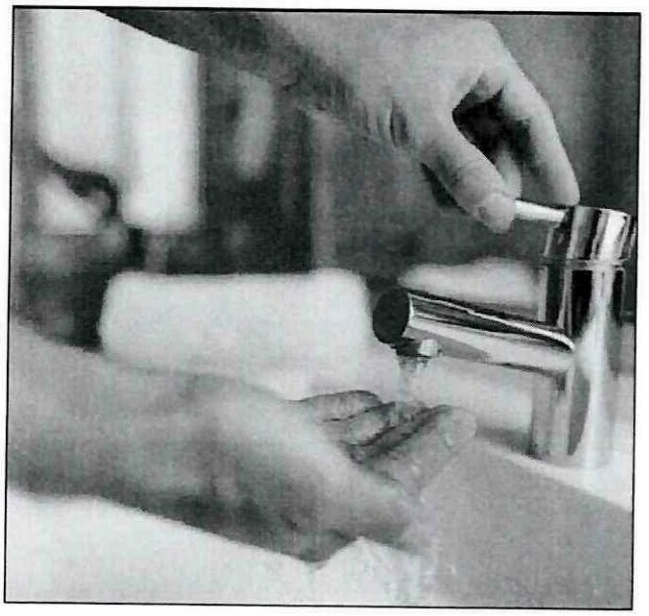

**Figure Q3 (b)**

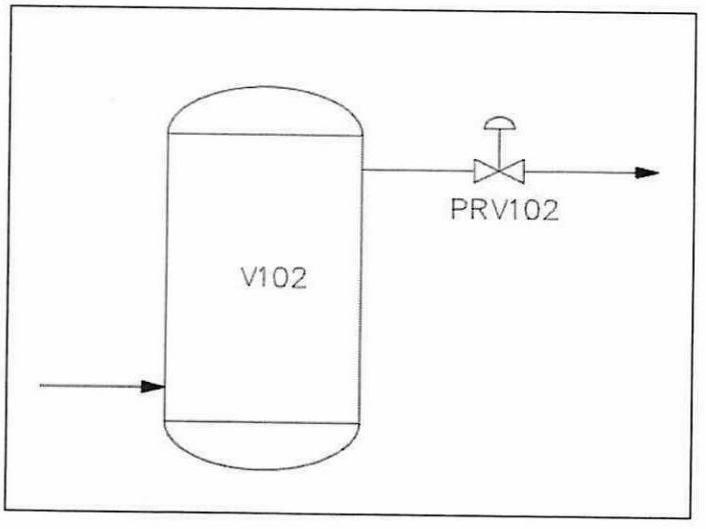


**Figure Q3 (c)**

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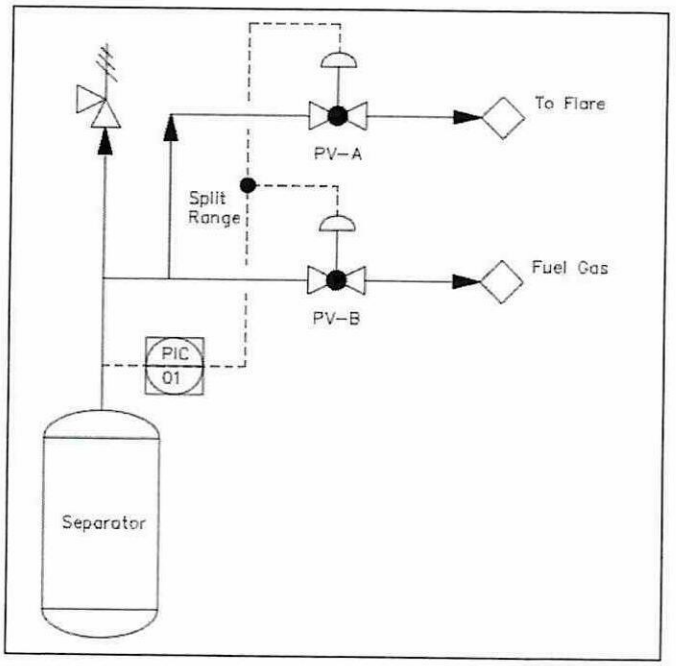


**Figure Q3 (d)**

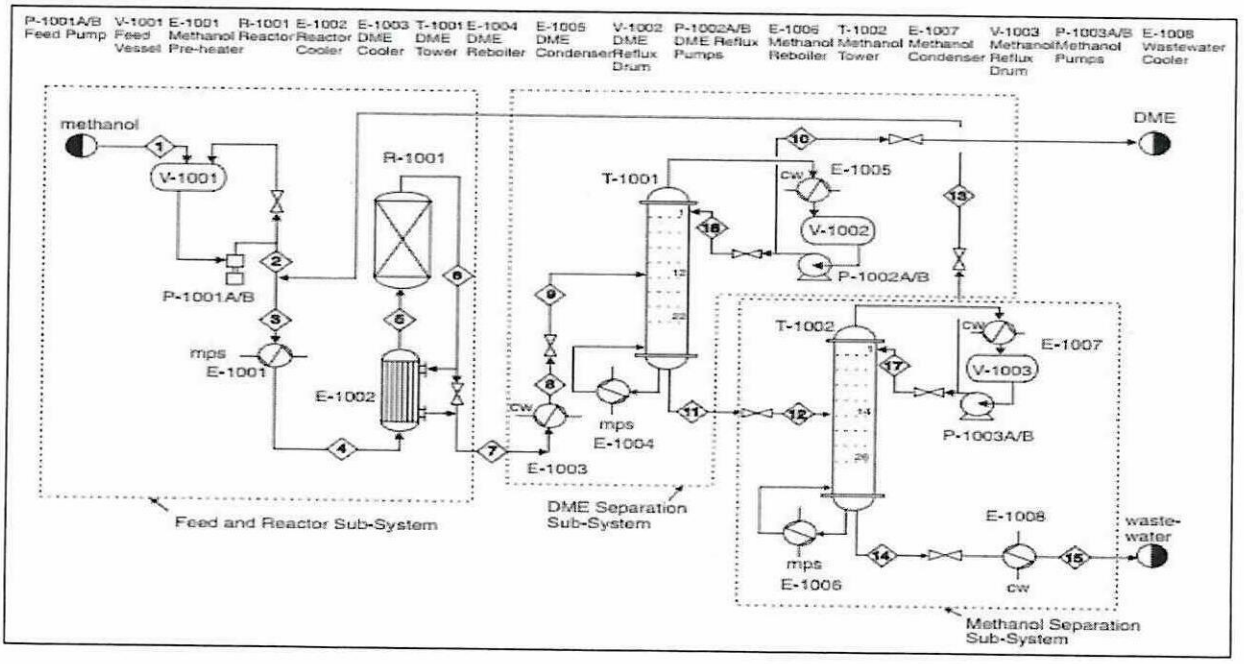


**Figure Q4 (b)**

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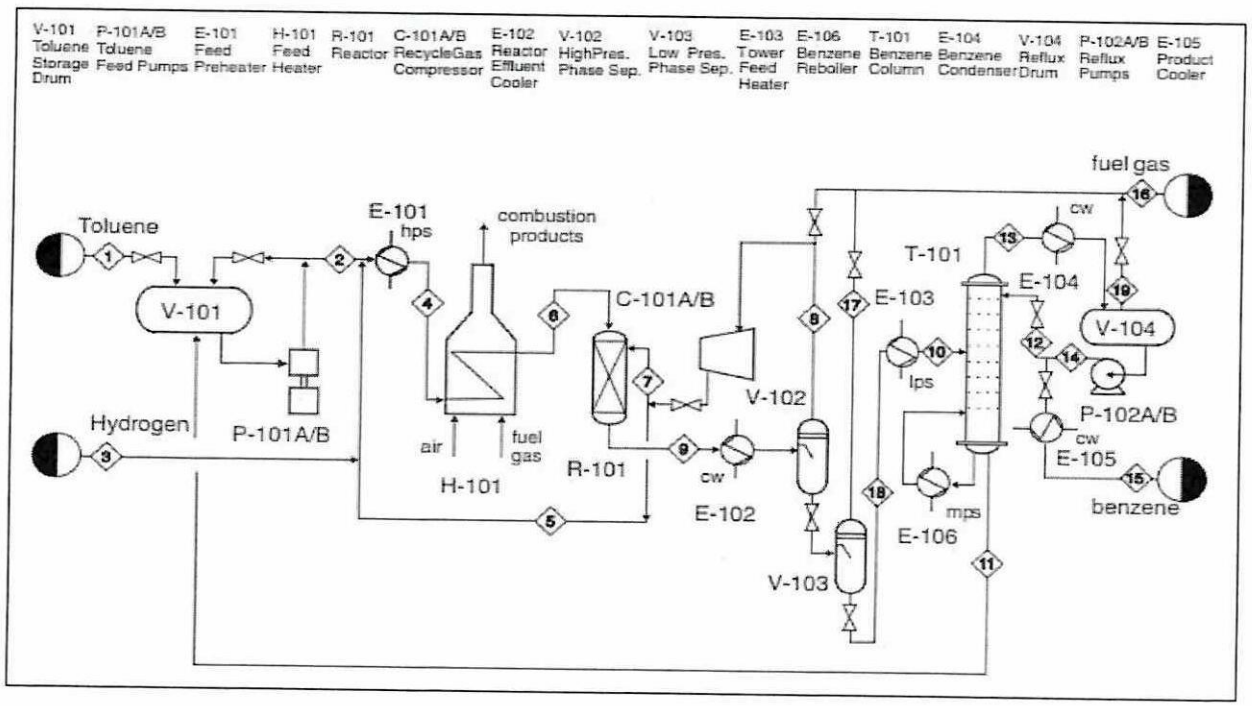


**Figure Q4 (c)**

**Table Q4 (c)**

| Guide Word | Deviation | Cause | Consequences | Action |
|---|---|---|---|---|
| No | | | | |
| No | | | | |
| More of | | | | |
| More | | | | |