

# **MECH4880 REFRIGERATION AND AIR CONDITIONING**

## **ASSIGNMENT 2 – (Laboratory 2017)**

### **REFRIGERATION DEMONSTRATION SYSTEM**

#### **OBJECTIVE**

To use the refrigeration demonstration systems to enhance your understanding of vapour compression processes. In addition you will investigate the effect of various operating parameters on the performance of refrigeration systems.

#### **EQUIPMENT**

The major components of the refrigeration demonstration apparatus include the compressor, condenser, throttling device and evaporator.

#### **QUESTION 1**

- a) Identify all the major parts in Figure 1.
- b) Discuss the roles of the components not shown on the 4 phase refrigeration cycle (Figure 2).
- c) Observe readings and values on the P-h diagram and the changes associated with varying parameters.
- d) What type of throttling devices are used? What changes are observed between the inlet and outlet of the throttling device?
- e) Observe the sight glass in the liquid line. What would be the effect of presence of gas bubbles.
- f) How much sub-cooling is taking place? How much superheat?
- g) What is observed when the condenser fan fails? Discuss.
- h) What effect does a failed evaporator fan have on the system?
- i) What effect does a blocked capillary have? Why is this commonly mistaken with an under charged system?
- j) Discuss the problems with an over charged system.

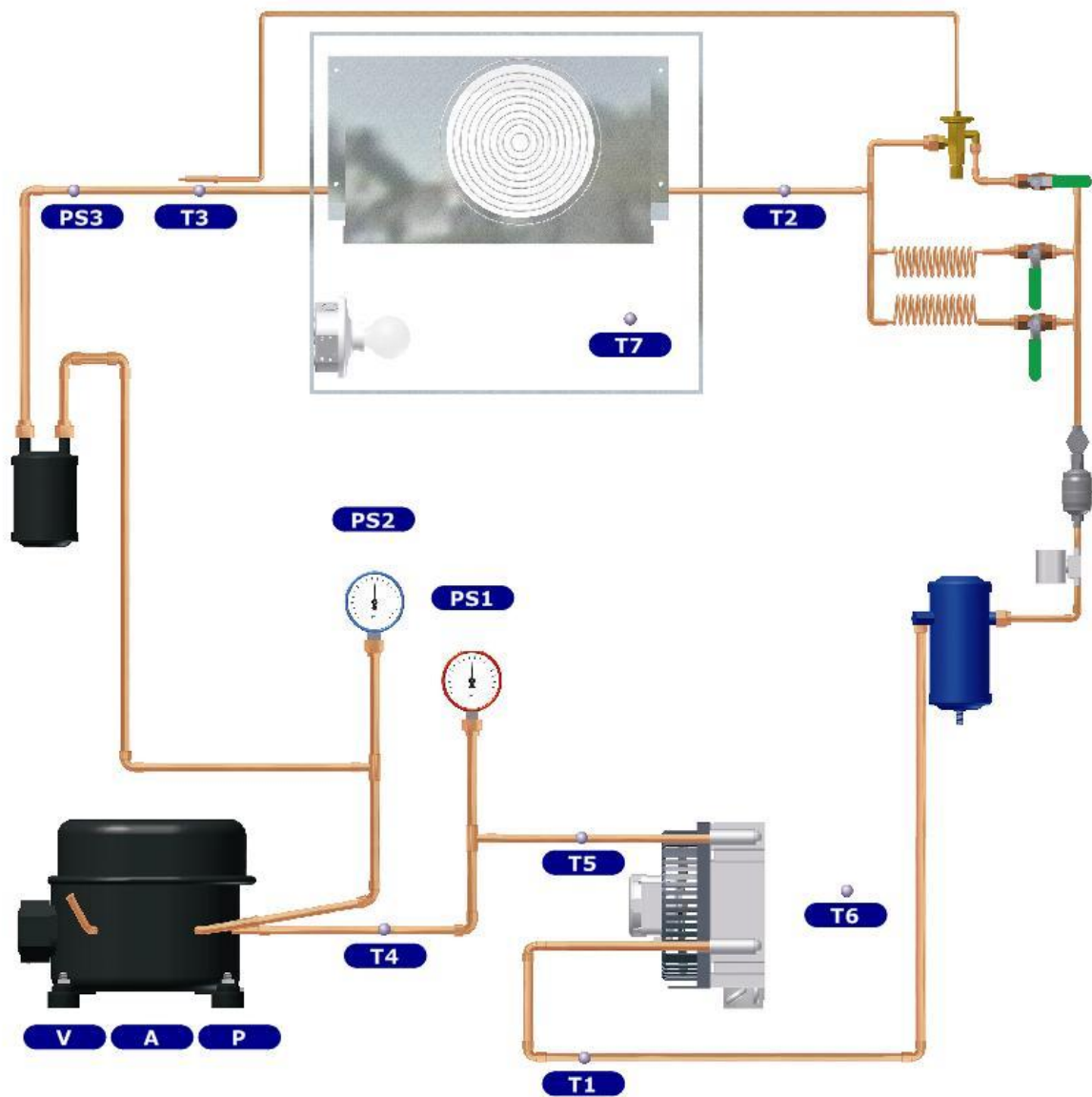


Figure 1 Lab-Volt Refrigeration Demonstration System

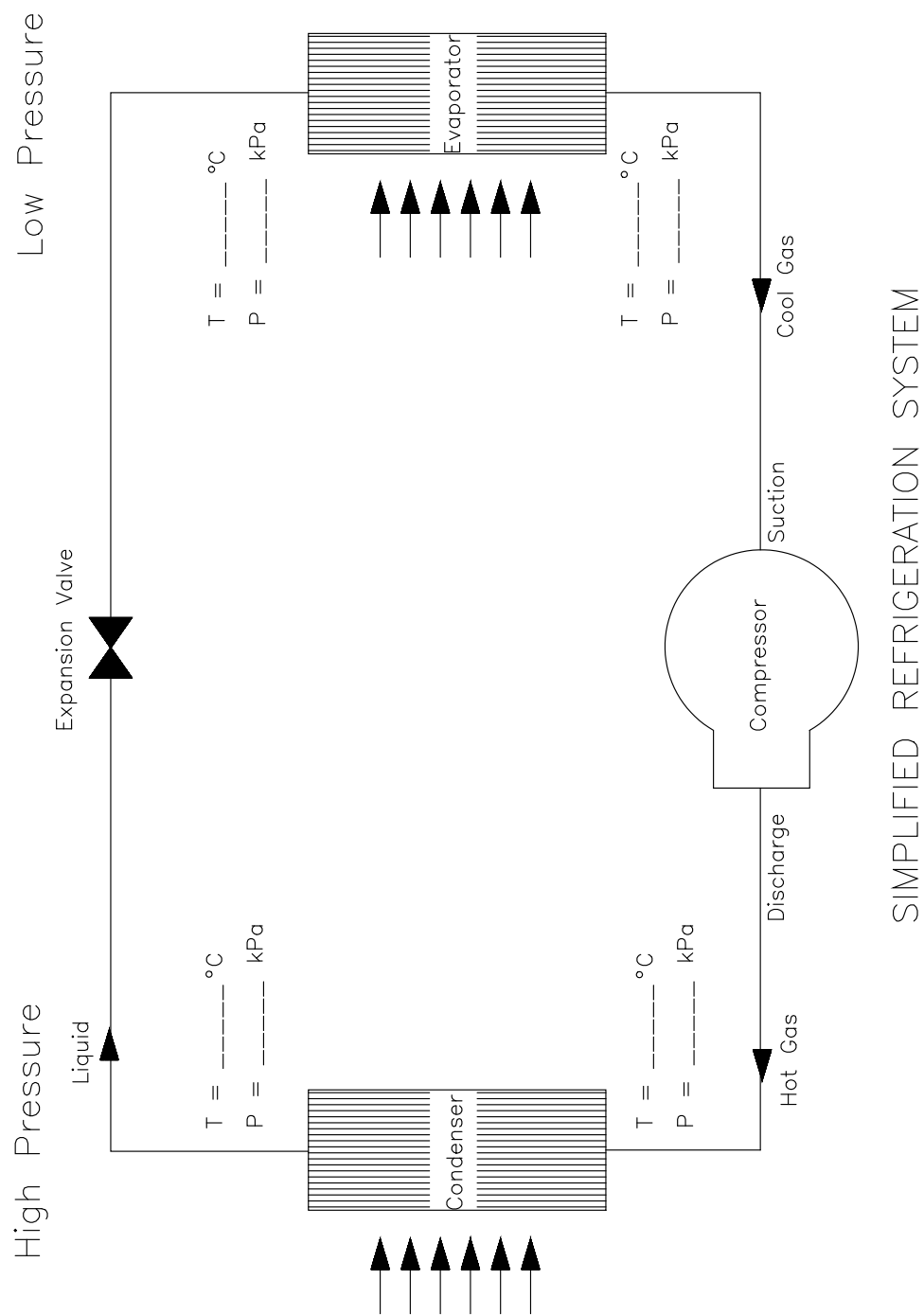
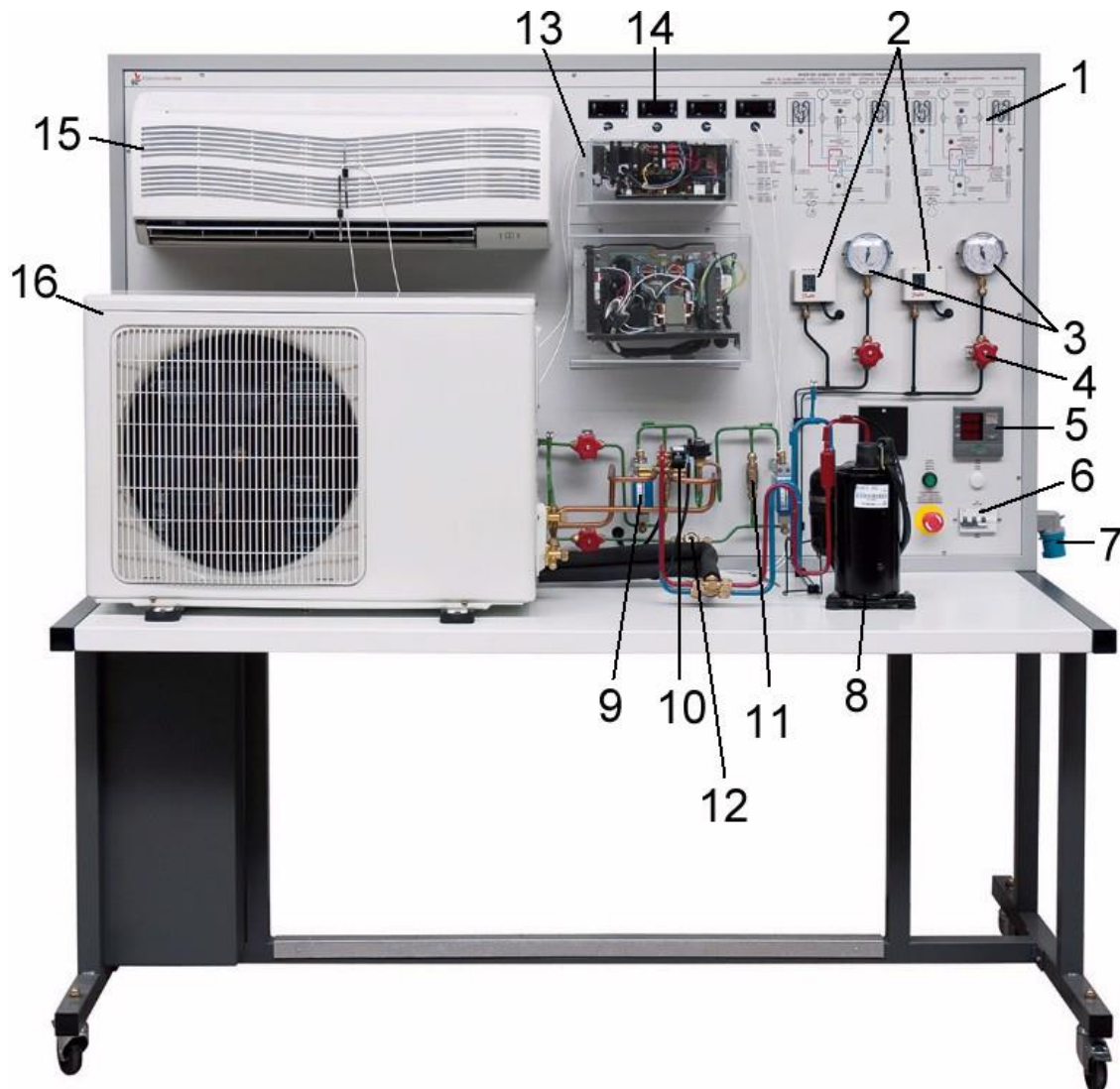


Figure 2 Simplified Refrigeration System

## AIR CONDITIONER (INVERTER TYPE) DEMONSTRATION SYSTEM



- |   |                           |
|---|---------------------------|
| 1. Plate of aluminium and schematic diagram     | 9. Flowmeter              |
| 2. High-pressure and low-pressure switches      | 10. Cycle inversion valve |
| 3. High-pressure and low-pressure gauges        | 11. Check valve           |
| 4. Manual on-off valve                          | 12. Sight glass           |
| 5. Digital instrument for electric measurements | 13. Electronic equipment  |
| 6. Control switches                             | 14. Digital thermometers  |
| 7. Single-phase power supply with grounding     | 15. Indoor unit           |
| 8. Airtight compressor                          | 16. Outdoor unit          |

Figure 3 Representation of the Equipment and Main Components

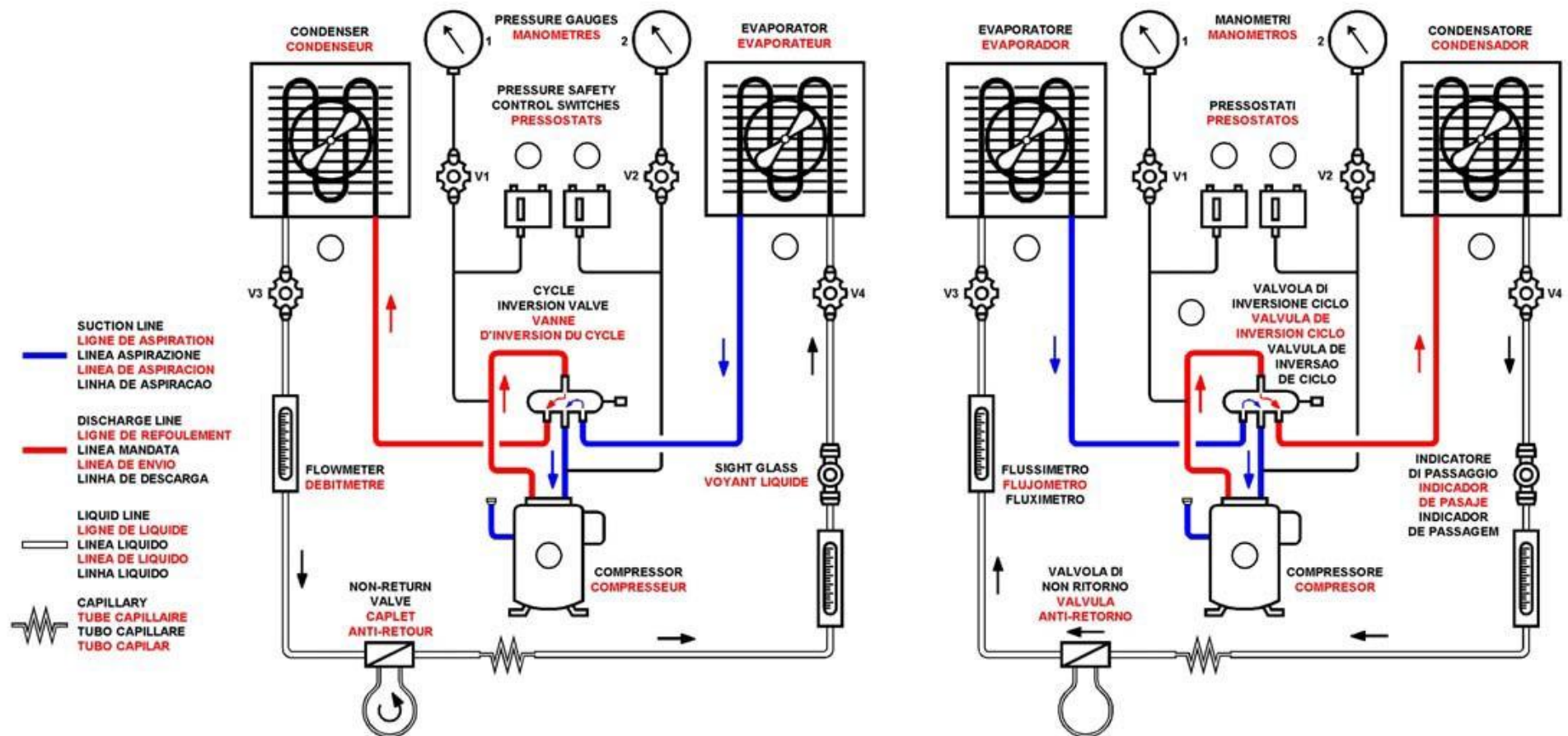
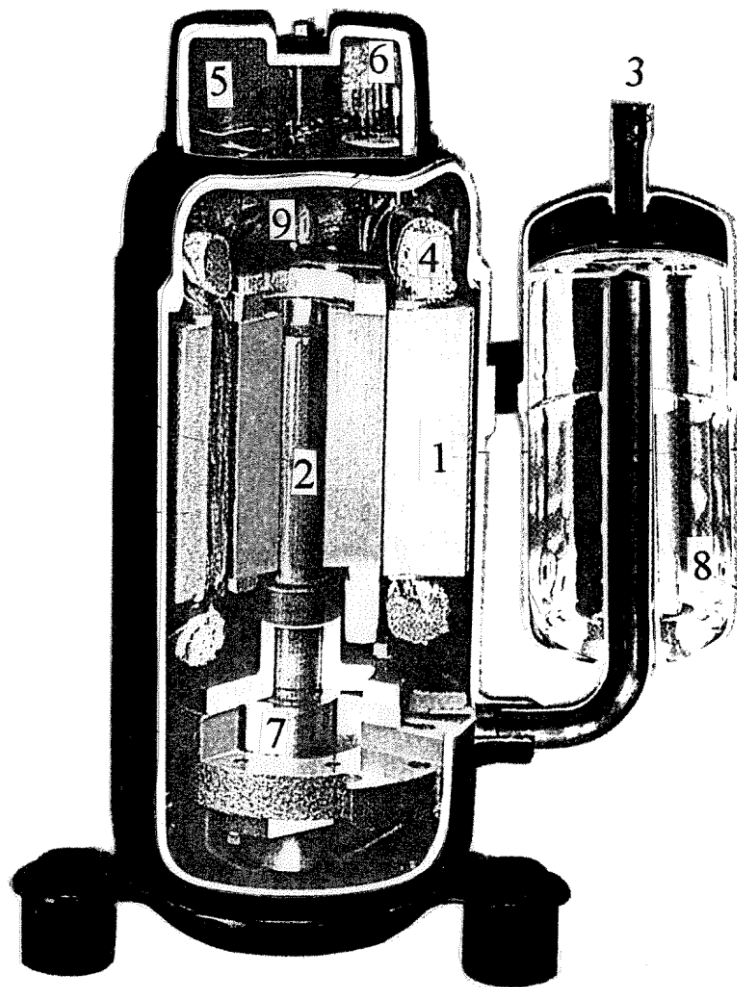


Figure 4 Schematic diagram of the cooling and heating modes



Cross section of a rotary compressor:

- |                                 |                      |
|---------------------------------|----------------------|
| 1. Stator of the electric motor | 5. Thermal protector |
| 2. Drive shaft                  | 6. Terminal board    |
| 3. Suction pipe                 | 7. Rotary piston     |
| 4. Winding                      | 8. Liquid separator  |
|                                 | 9. Delivery pipe     |

Figure 5 Rotary airtight compressor (Displacement = 8,9 cm<sup>3</sup>/rev)

## QUESTION 2

The following exercises can be carried out with the help of the P-H diagram, Figure 6.

Before carrying out the representation of the cycle indicated on the log. P-h diagram of the refrigerant R410A, measure the operating pressures of the cycle, as well as the suction and discharge temperatures of the gas and the temperature of the refrigerant before crossing the capillary tube.

The position of the probes for detecting the parameters of these calculations is shown in the Figure 7.

### Part A

- a) Draw the refrigeration cycle on the P-h diagram
- b) Calculate the enthalpy change for the refrigeration effect.
- c) Calculate the enthalpy change for the heat rejected at the condenser
- d) Calculate the enthalpy change during compression.
- e) Calculate the EER of the system.

### Part B

Discuss three ways by which the EER of the system can be improved. In the discussion you should also consider the feasibility of making the proposed changes.

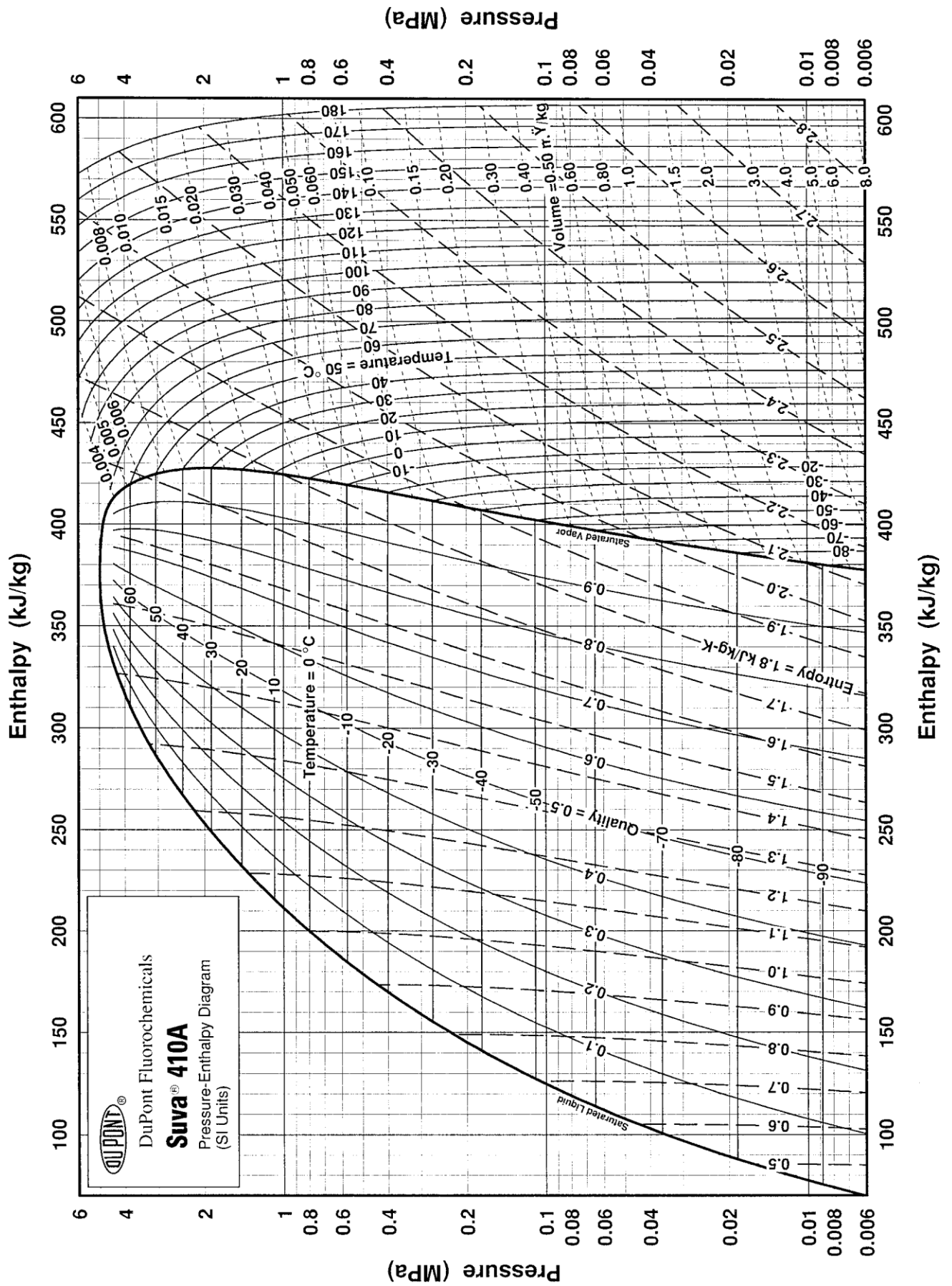


Figure 6 R410a P-h diagram



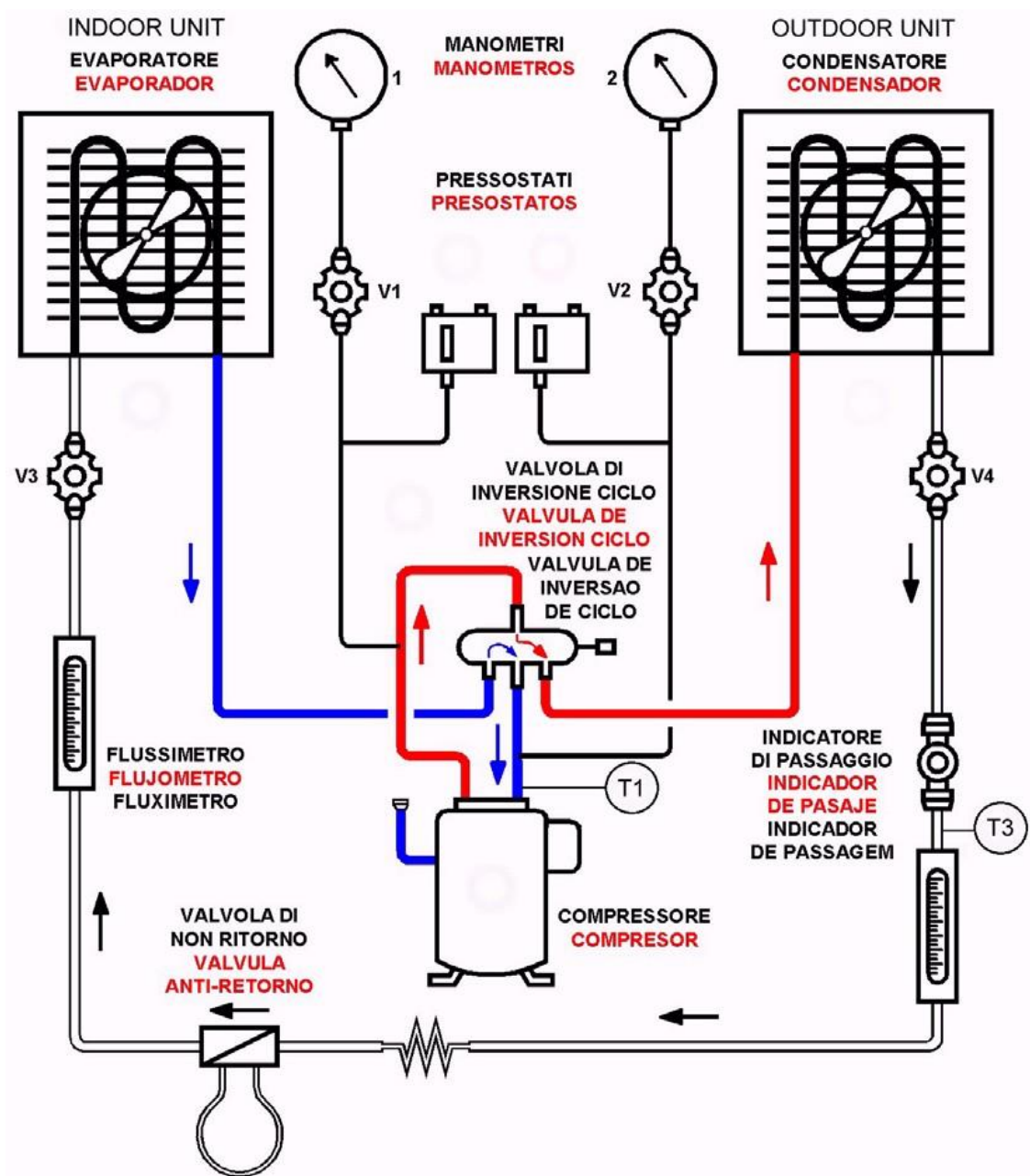


Figure 7 Cooling mode schematic diagram

## REPORT SUBMISSION

- You are required to submit a report addressing the above questions. The report should be in a professional format with an abstract and table of contents.
- Submission is via the online submission tool on Moodle.
- Late submission penalty is 10% per day.
- The Assignment 2 report is due on or before 9pm, 3rd October 2017.

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