EXPERIMENT NUMBER: 5

EXPERIMENT NAME : Multipurpose Refrigeration Cycle

EXPERIMENTAL SETUP: Multipurpose Refrigeration Training Set

Figure 1. Front View of Multipurpose Refrigeration Training Set

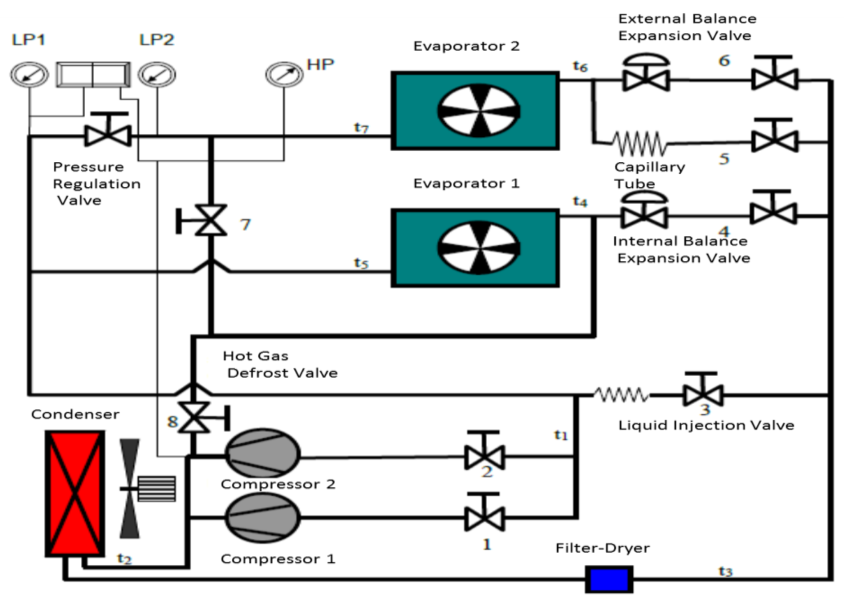


Figure 2. Multipurpose Refrigeration Set Flow Diagram

AIM OF THE EXPERIMENT

1) Introduction of the refrigeration cycle
2) Examination of the elements used in the refrigeration cycle,
3) Examining the p-h and t-s diagrams of the refrigeration cycle

THEORY

A major application area of thermodynamics is refrigeration, which is the transfer of heat from a lower temperature region to a higher temperature one. Devices that produce refrigeration are called refrigerators, and the cycles on which they operate are called refrigeration cycles. The most frequently used refrigeration cycle is the vapor-compression refrigeration cycle in which the refrigerant is vaporized and condensed alternately and is compressed in the vapor phase.The vapor-compression refrigeration cycle is used for refrigerators, air-conditioning systems, and heat pumps. It consists of four processes:

1-2 Isentropic compression in a compressor

2-3 Constant-pressure heat rejection in a condenser

3-4 Throttling in an expansion device

4-1 Constant-pressure heat absorption in an evaporator

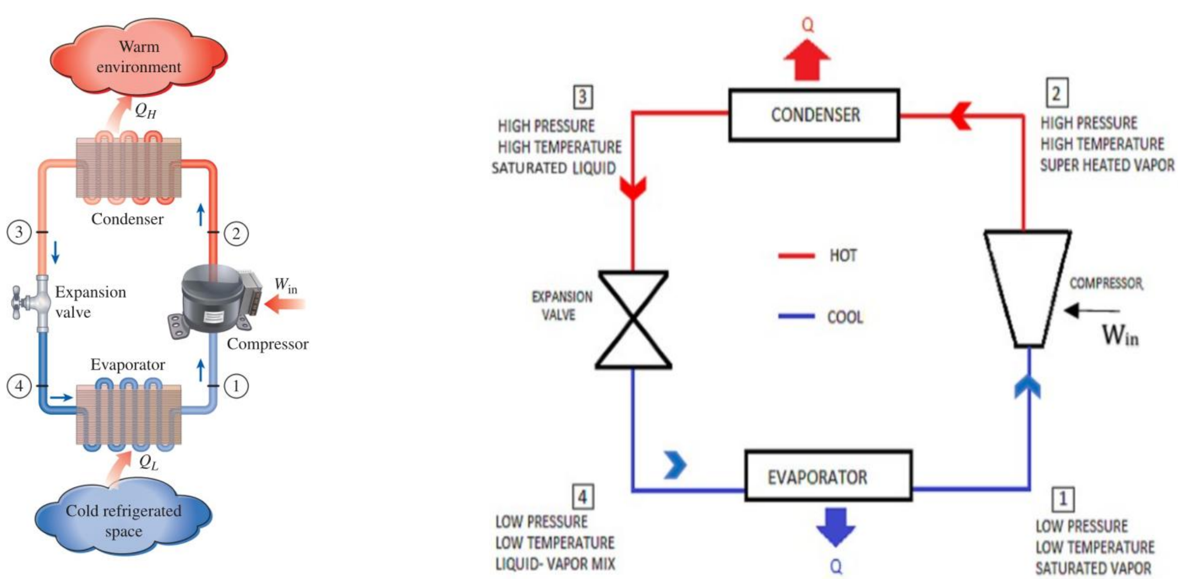


Figure 3. Schematic representation of the ideal vapor-compression refrigeration cycle

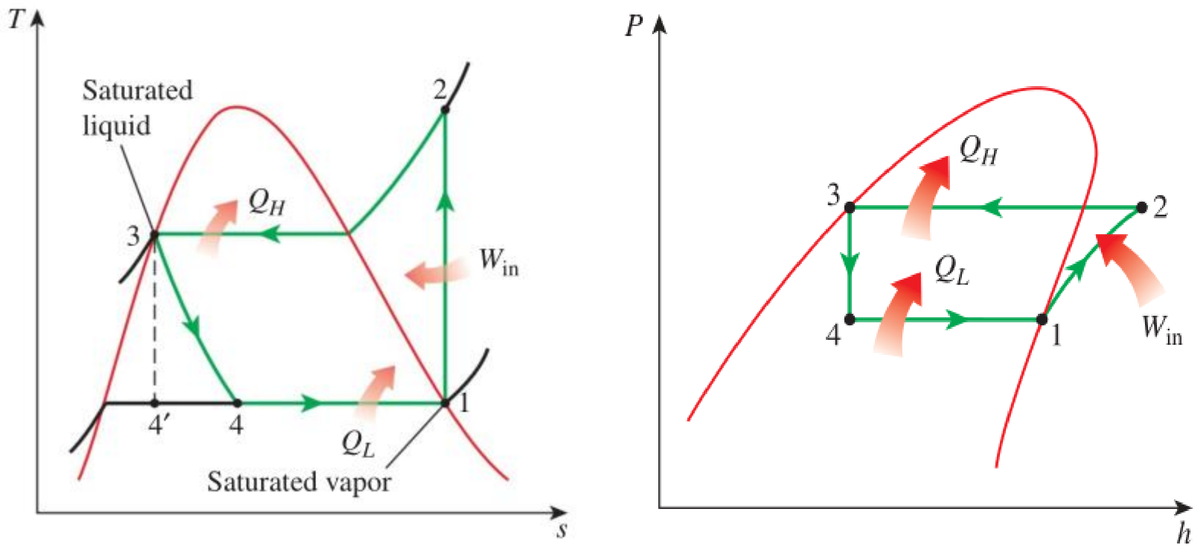


Figure 4. T-s and P-h diagram for the ideal vapor-compression refrigeration cycle.

In an ideal vapor-compression refrigeration cycle, the refrigerant enters the compressor at state 1 as saturated vapor and is compressed isentropically to the condenser pressure. The temperature of the refrigerant increases during this isentropic compression process to well above the temperature of the surrounding medium. The refrigerant then enters the condenser as superheated vapor at state 2 and leaves as saturated liquid at state 3 as a result of heat rejection to the surroundings. The temperature of the refrigerant at this state is still above the temperature of the surroundings. The saturated liquid refrigerant at state 3 is throttled to the evaporator pressure by passing it through an expansion valve or capillary tube. The temperature of the refrigerant drops below the temperature of the refrigerated space during this process. The refrigerant enters the evaporator at state 4 as a low-quality saturated mixture, and it completely evaporates by absorbing heat from the refrigerated space. The refrigerant leaves the evaporator as saturated vapor and reenters the compressor, completing the cycle.

EXPERIMENTAL PROCEDURE

1) Turn on valves number 1 and 4 and turn off the remaining valves

2) Swich on compressor number 1 and eveporator number 1 and condenser fans

3) When the system thermodynamic equilibrium is achived , record the values and stop the system

EXPLANATIONS

1) Condenser pressure drop can be ignored so $p_2=p_3$ can be assumed.

2) $h_3=h_4$ expansion process as adiabatic (no heat transfer)

3) Do not forget to add atmospheric pressure pressure to the measured gauge pressure (approximately 101.325 kPa)

CALCULATION FORMULAS

Refrigeration capacity (Heat transfer)

$Q_{ref} = m_r (h_1 - h_4)$ [W]

Compressor capacity (Work Done By Compressor)

$W_{comp} = m_r (h_2 - h_1)$ [W]

Condensation capacity (Heat transfer)

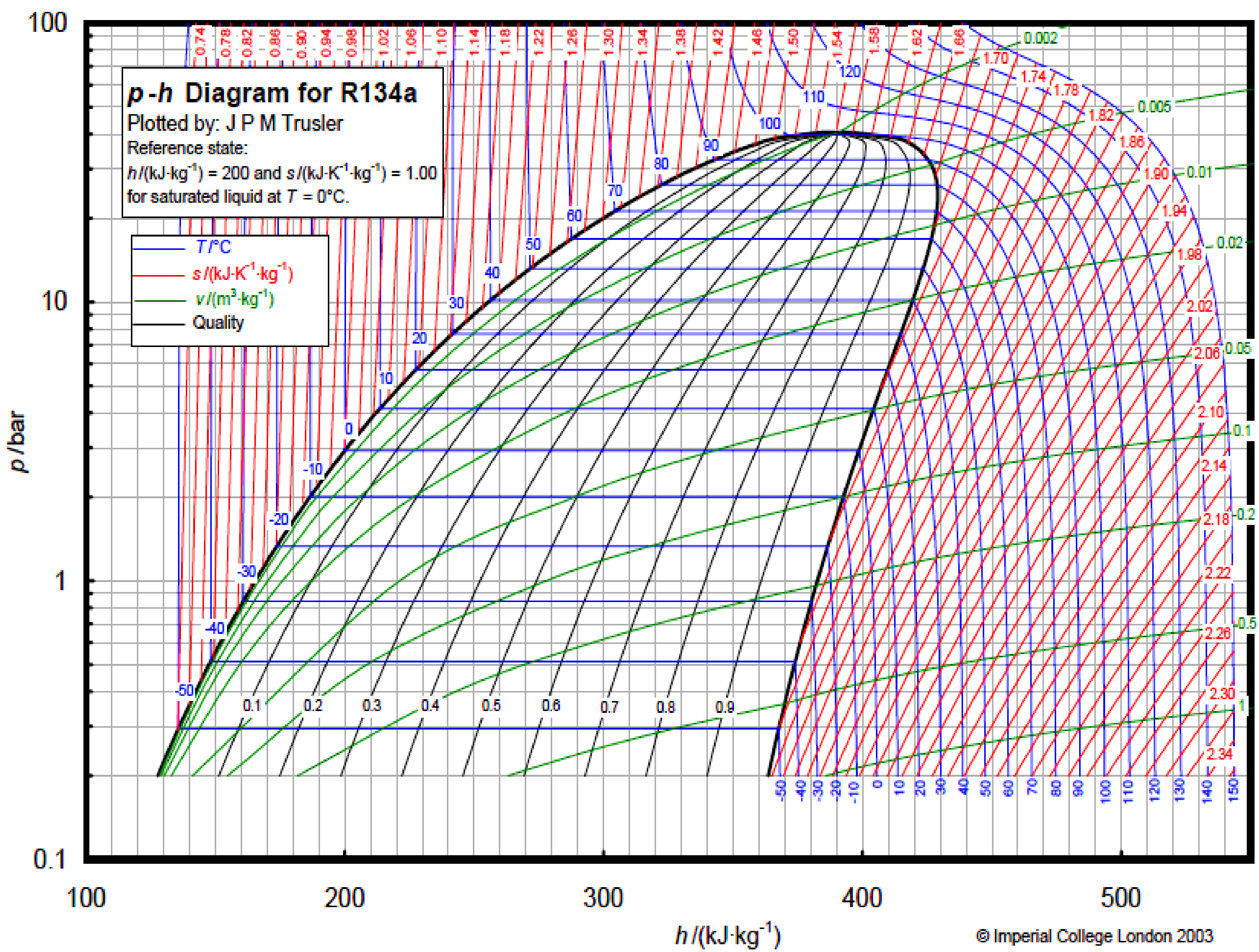
$Q_{cond}= m_r (h_3 - h_2)$ [W]

COPs of refrigerators

$$COP_R = \frac{q_L}{w_{net,in}} = \frac{h_1 - h_4}{h_2 - h_1}$$

Properties/ Number of measurements	**Scale to read**	**1**	**2**	**3**
1) Condenser pressure, p_2 [kPa]	HP			
2) Compressor exit temperature , t_2 [^{0}C]	t2			
3) Evaporator pressure, p_1 [kPa]	LP2			
4) Compressor inlet temperature, t_1 [^{0}C]	t1			
5) Liquid line temperature t_3[^{0}C]	t3			
6) Evaporator inlet temperature, t_4 [^{0}C]	t4			
7) Refrigerant mass flow rate, m_r [g/s]	Electronic flow measurement device			

REQUIREMENTS IN REPORT: Experiment number, name and aim of the experiment. The table values, calculations and explanations and p-h diagrams.


p-h Diagram for R134a
Plotted by: J P M Trusler
Reference state:
h/(kJ·kg-1) = 200 and s/(kJ·K-1·kg-1) = 1.00
for saturated liquid at T = 0°C.
T/°C
s/(kJ·K-1·kg-1)
v/(m3·kg-1)
Quality
p /bar
h /(kJ·kg-1)