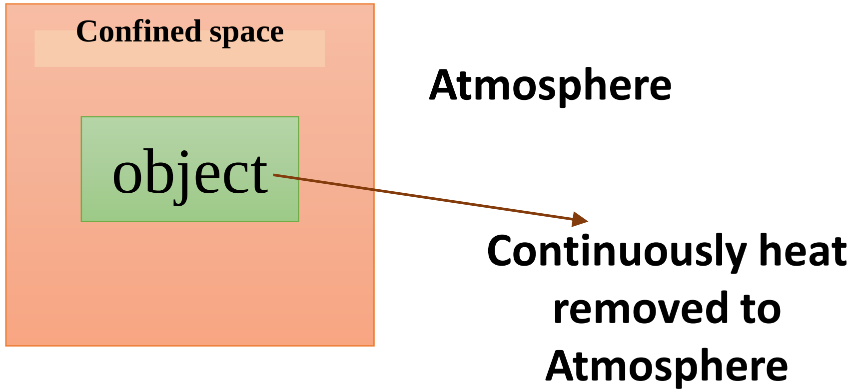
Refrigeration & Air condition (R & AC)

Refrigeration:

- method of reducing the temperature of a system below that of the surroundings and maintains it at the lower temperature by continuously abstracting the heat from it.



- The fundamental reason for having a **refrigerator** is to keep food cold – it slow down the activity of bacteria (which all food contains) so that it takes longer for the bacteria to spoil the food

Refrigeration & Air condition (R & AC)

Air condition :

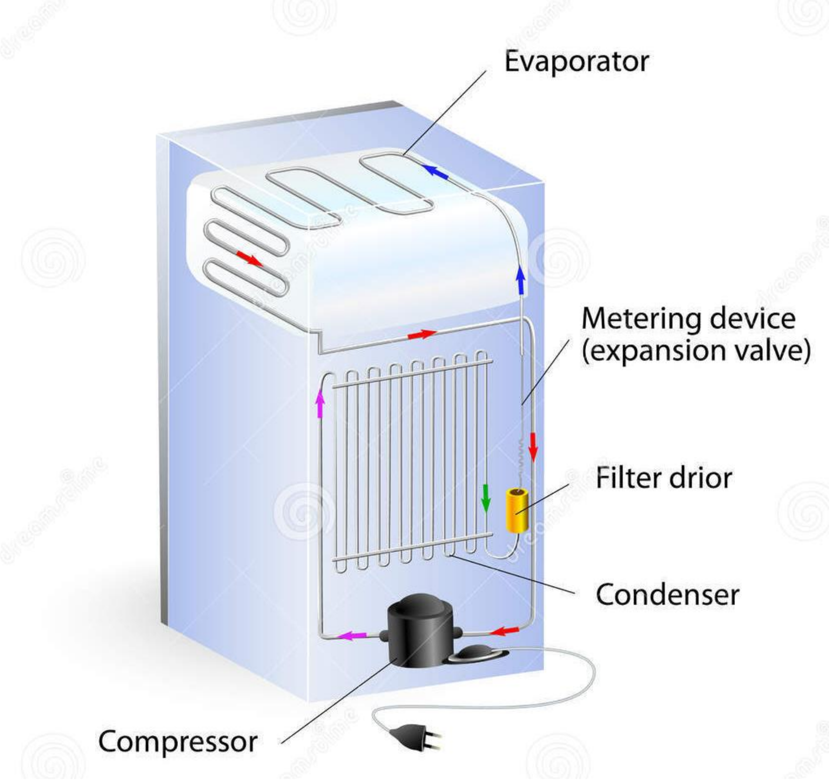
- Providing a cool constant indoor atmosphere at all times regardless of weather conditions needed either for human comfort or industrial purposes
- Air conditioning by artificially cooling, humidifying or dehumidifying, cleaning and recirculating the surrounding air

•Commercial buildings, which are built for commerce, including offices, malls, shopping centers, restaurants, etc.
•Industrial spaces where thermal comfort of workers is desired
•Cars, aircraft, boats, which transport passenger or fresh goods
•Sports stadiums
•Chemical and biological industries & laboratories

Refrigeration

Refrigeration :

Is a process



Refrigerator:

Is a device/machine

Refrigerant:

Is a working fluid used to extract heat from object/confined space to rejected to atmosphere

Refrigeration

Properties of good Refrigerants:

Refrigerant should not undergo any chemical change, but carries heat by evaporating at a low temperature & pressure and gives up heat by condensing at higher temperature pressure.

Thermodynamic Properties

1. A good refrigerant must have a low boiling temperature at atmospheric pressure.
2. A good refrigerant must have a very low freezing point because the refrigerant should not freeze at low temperatures.
3. In order to avoid the leakage of the atmospheric air and also to enable the detection of the leakage of the refrigerant, both the evaporator and condenser pressures should be slightly above the atmospheric pressure.
4. The latent heat of evaporation must be very high so that a minimum amount of refrigerant will accomplish the desired result in other words, it other words, it increases the refrigeration effect.
5. The specific volume of the refrigerant must be very low.

Physical properties

1. A good refrigerant must have low specific heat when it is in liquid state and high specific heat when it is vaporized.
2. The viscosity of a refrigerant at both the liquid and vapour states must be very low as it improves the heat transfer and reduces the pumping pressure.

Refrigeration

Properties of good Refrigerants:

Chemical Properties

1. A good refrigerant should be non-toxic.
2. A good refrigerant should be non-corrosive to prevent the corrosion of the metallic parts of the refrigerators.
3. Chemical stability an ideal refrigerant must not decompose under operating conditions.
4. The coefficient of performance of a refrigerant must be high so that the energy spent in refrigeration will be less.
5. A good refrigerant must be odourless, otherwise some foodstuff such as meat, butter, etc. lose their taste.
6. A good refrigerant must not react with the lubricating oil used in lubricating the parts of the compressor.

Other Properties

It should be low cost

It should easy available and easily handled

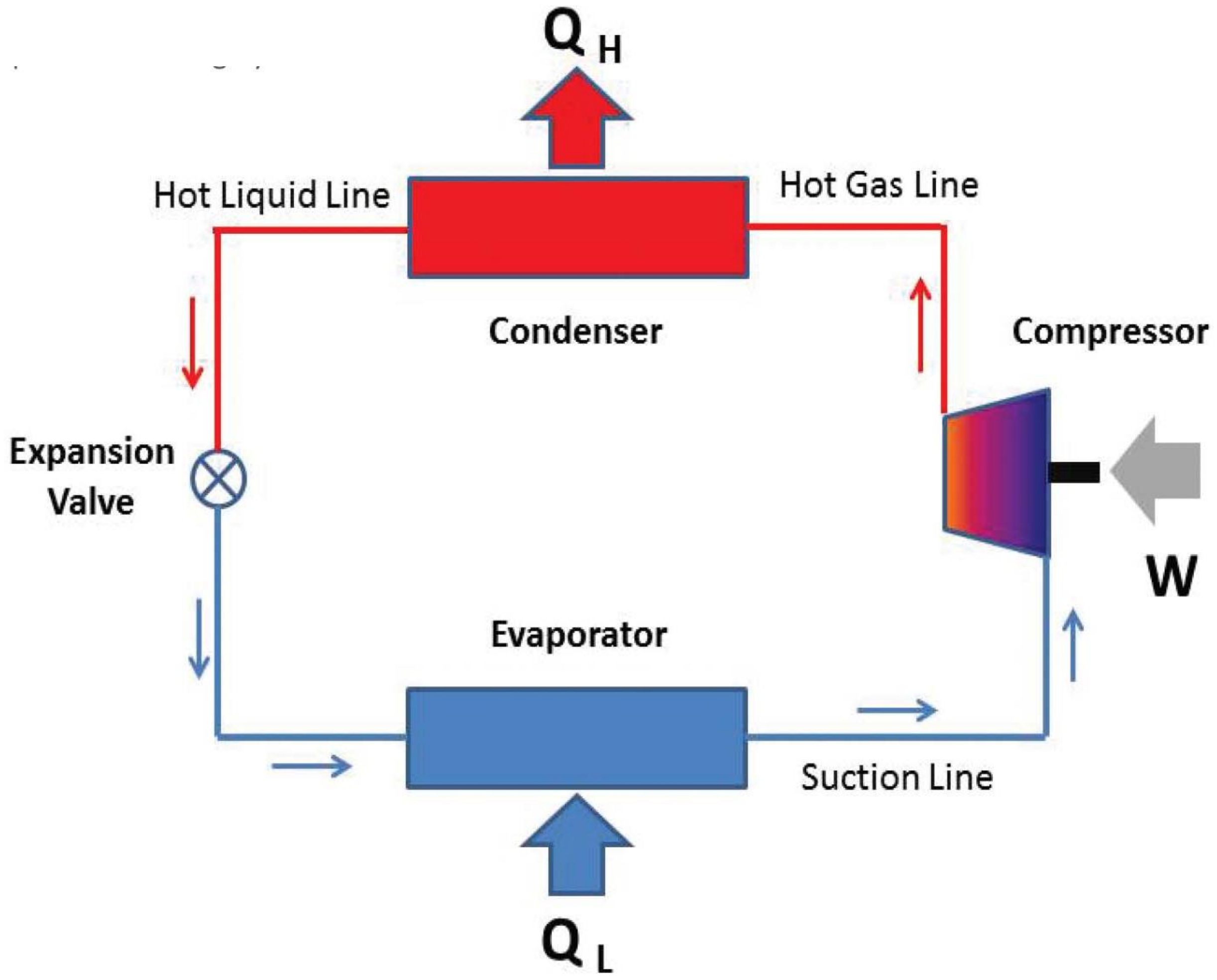
Refrigeration

Refrigerants:

Refrigerants	Uses	Boiling Temperature in ^{O}C	Properties
Ammonia (NH_3)	Vapour absorption refrigeration system	-33.3	Toxic, inflammable, irritating & corrosive
CO_2	Marine/ships refrigeration system	-77.6	Non Toxic, Nonflammable, Low specific volume
SO_2	Old (domestic refrigeration system)Vapour compression refrigeration system	-10	Colorless, suffocating, irritating odour
Freon-12 (Fe-12)	Domestic refrigeration system, water coolers, air conditioning systems(Vapour compression refrigeration system)	-29.8	Nonflammable, Non explosive, odourless
Freon-22 (Fe-22)	Domestic refrigeration system, water coolers, air conditioning systems(Vapour compression	-29.8	Nonflammable, Non explosive, odourless

Refrigeration

Components of Refrigerator:

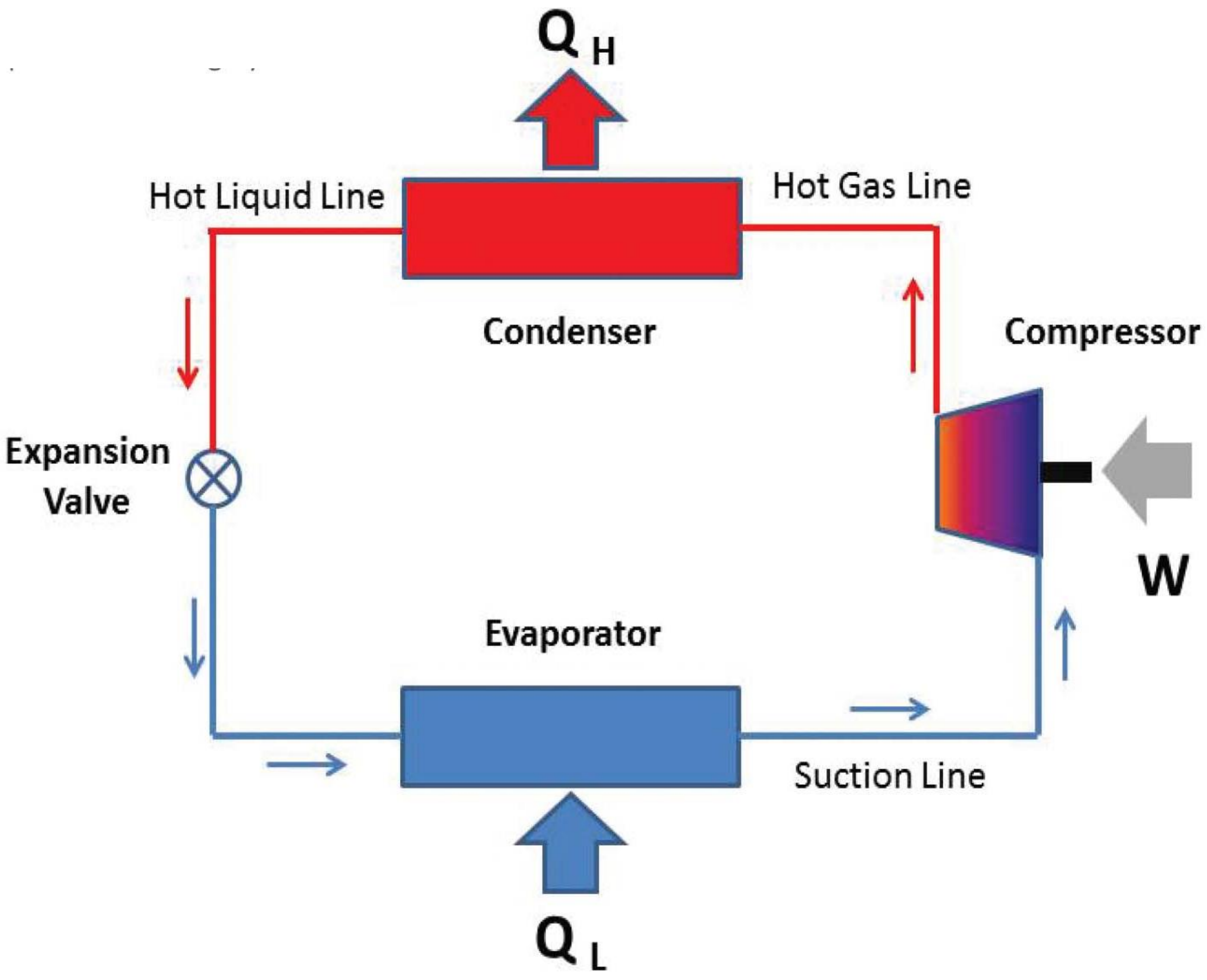


Evaporator:

- Low T (lesser than space), Low P (almost same as atmospheric pressure) liquid refrigerant enters
- Heat transfer from confined space to liquid refrigerant
- Low T (lesser than space), Low P (almost same as atmospheric pressure) liquid refrigerant get heated and coverts to High T (more than space but less than atmosphere), Low P (almost same as atmospheric pressure) , rich vapour – liquid refrigerant – No change in pressure due to refrigerant phase change at constant pressure
- High T (more than space but less than atmosphere), Low P rich vapour – liquid refrigerant leaves the evaporator

Refrigeration

Components of Refrigerator:



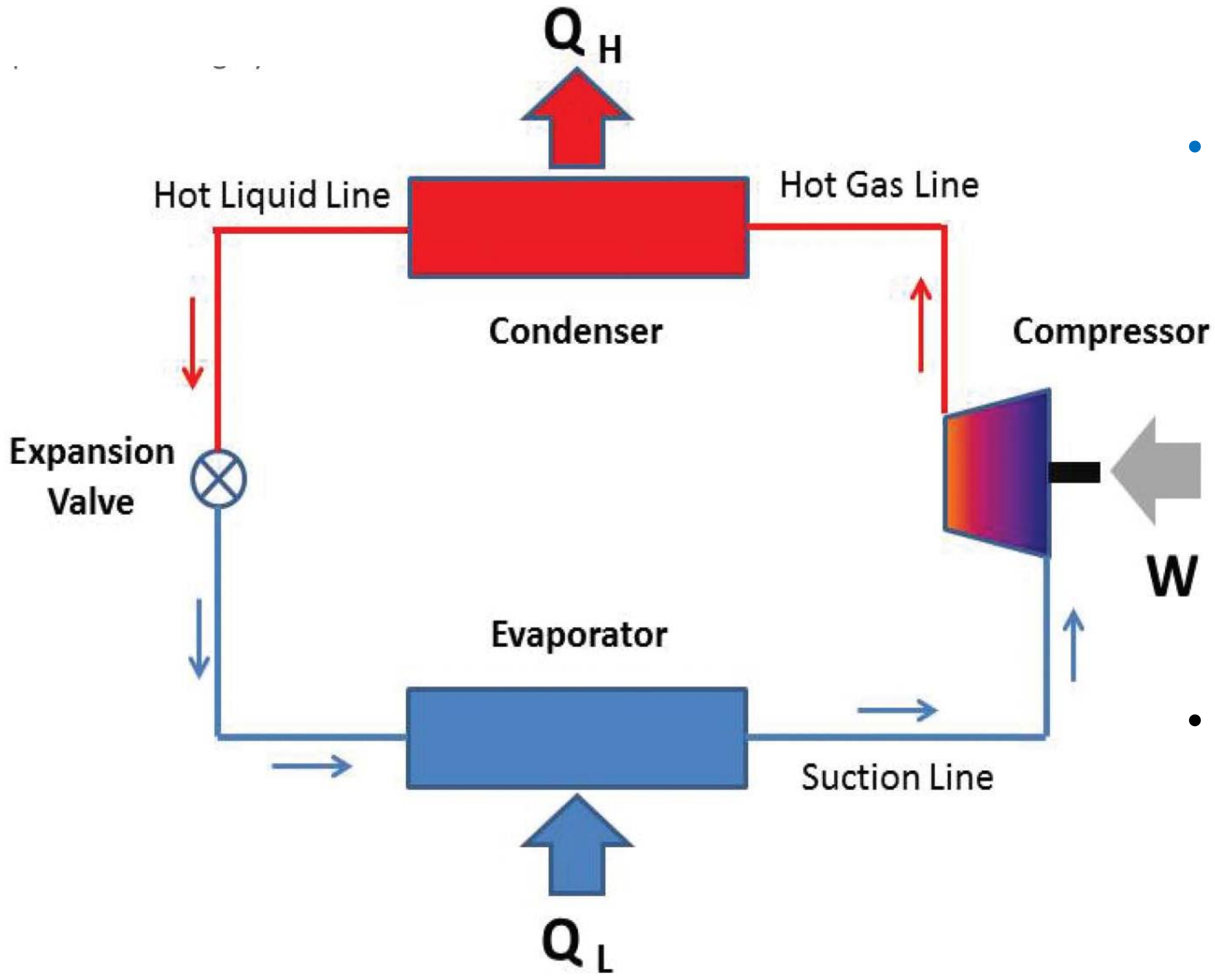
Compressor

- High T (more than space but less than atmosphere), Low P (almost same as atmospheric pressure) rich vapour – liquid refrigerant enters
- Compress of the rich vapour liquid refrigerant by external mechanical work (electrical energy)
- High T (more than space but less than atmosphere), Low P (almost same as atmospheric pressure) rich vapour – liquid refrigerant coverts to High P, High T (more than atmosphere) rich vapour – liquid refrigerant
- High P, High T (more than atmosphere) rich vapour – liquid refrigerant leaves the compressor

Refrigeration

Condenser

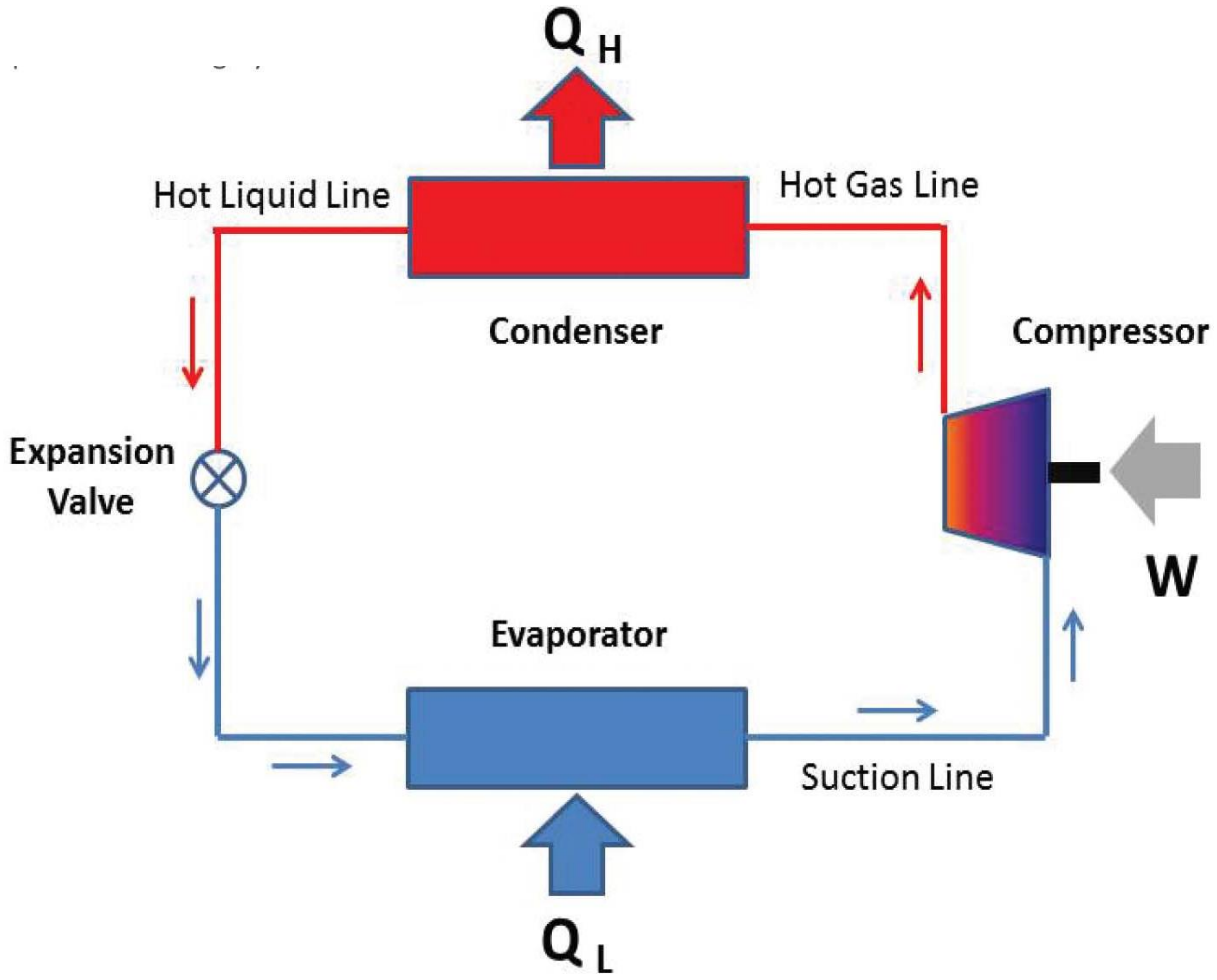
Components of Refrigerator:



- High P, High T (more than atmosphere) rich vapour – liquid refrigerant enters
- Condensation of rich vapour – liquid refrigerant by transferring heat to atmospheric air (i.e heat lost by refrigerant) and converts to Low T (almost same as atmosphere), High P (more than atmosphere) weak vapour – liquid refrigerant -No change in pressure due to refrigerant phase change at constant pressure
- Low T (almost same as atmosphere), High P (more than atmosphere) weak vapour – liquid refrigerant leaves the condenser

Refrigeration

Components of Refrigerator:



Expansion/Throttle Valve

- High P (more than atmosphere), Low T (almost same as atmosphere) weak vapour – liquid refrigerant enters
- Expansion of vapour present in the weak vapour liquid mixture refrigerant, so decreases of pressure and temperature from high to lower value
- Control the quantity of refrigerant to evaporator based on the amount heat to be removed from space
- Low P (almost same as atmospheric pressure), Low T (lesser than space) liquid refrigerant leaves the expansion valve

Refrigeration System

There are two types of Refrigeration system:

1. Vapour compression refrigeration system (VCRS)

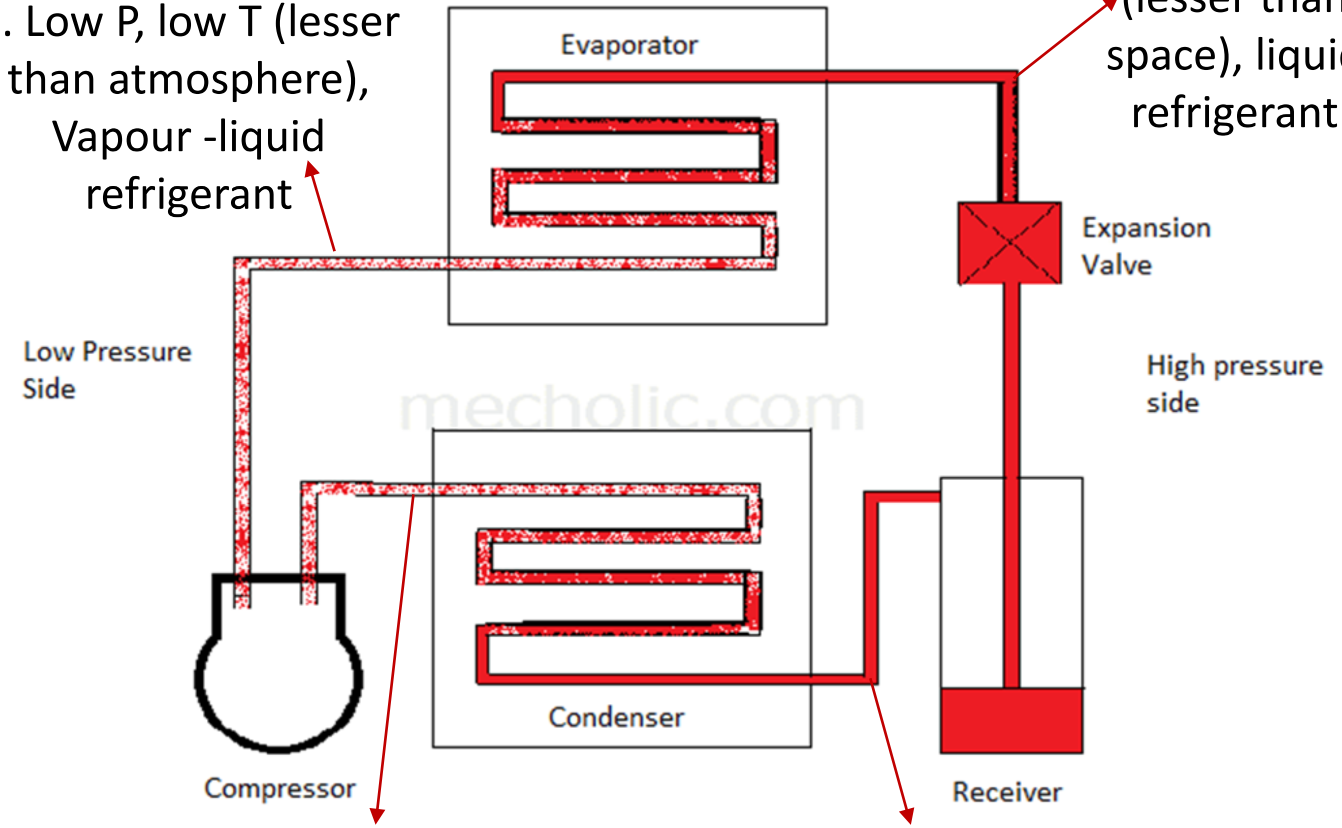
2. Vapour absorption refrigeration system (VARS)

Refrigeration System

1.Vapour compression refrigeration system (VCRS) – requires electricity

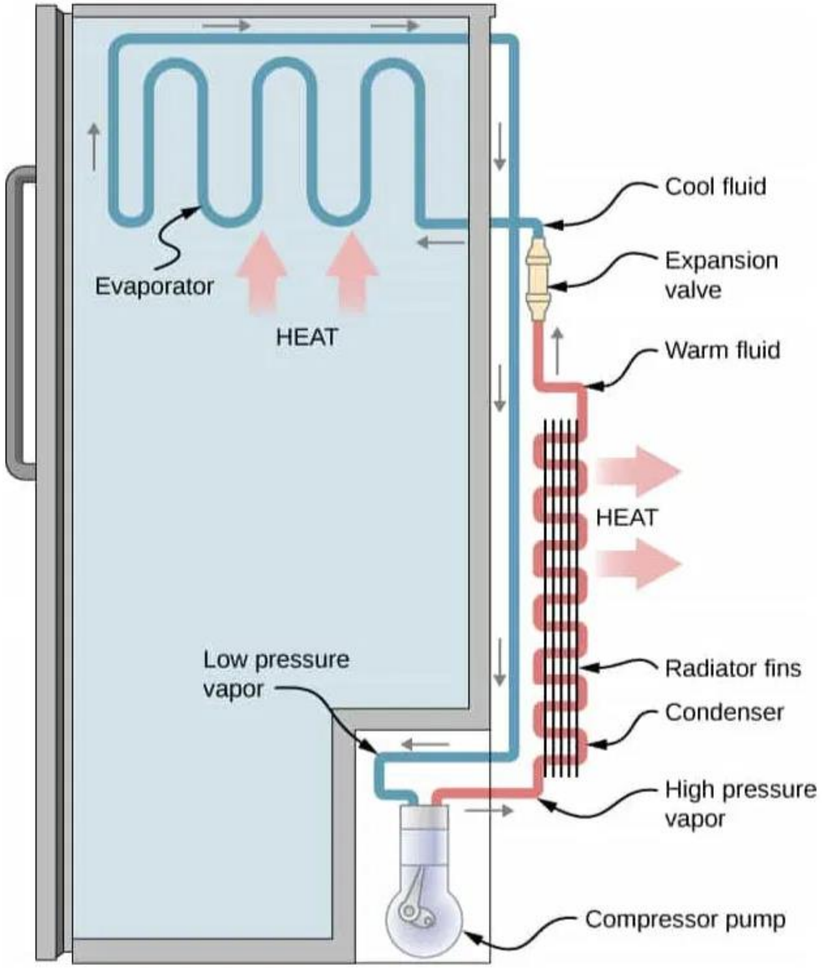
1. Low P, low T (lesser than space), liquid refrigerant

2. Low P, low T (lesser than atmosphere), Vapour -liquid refrigerant



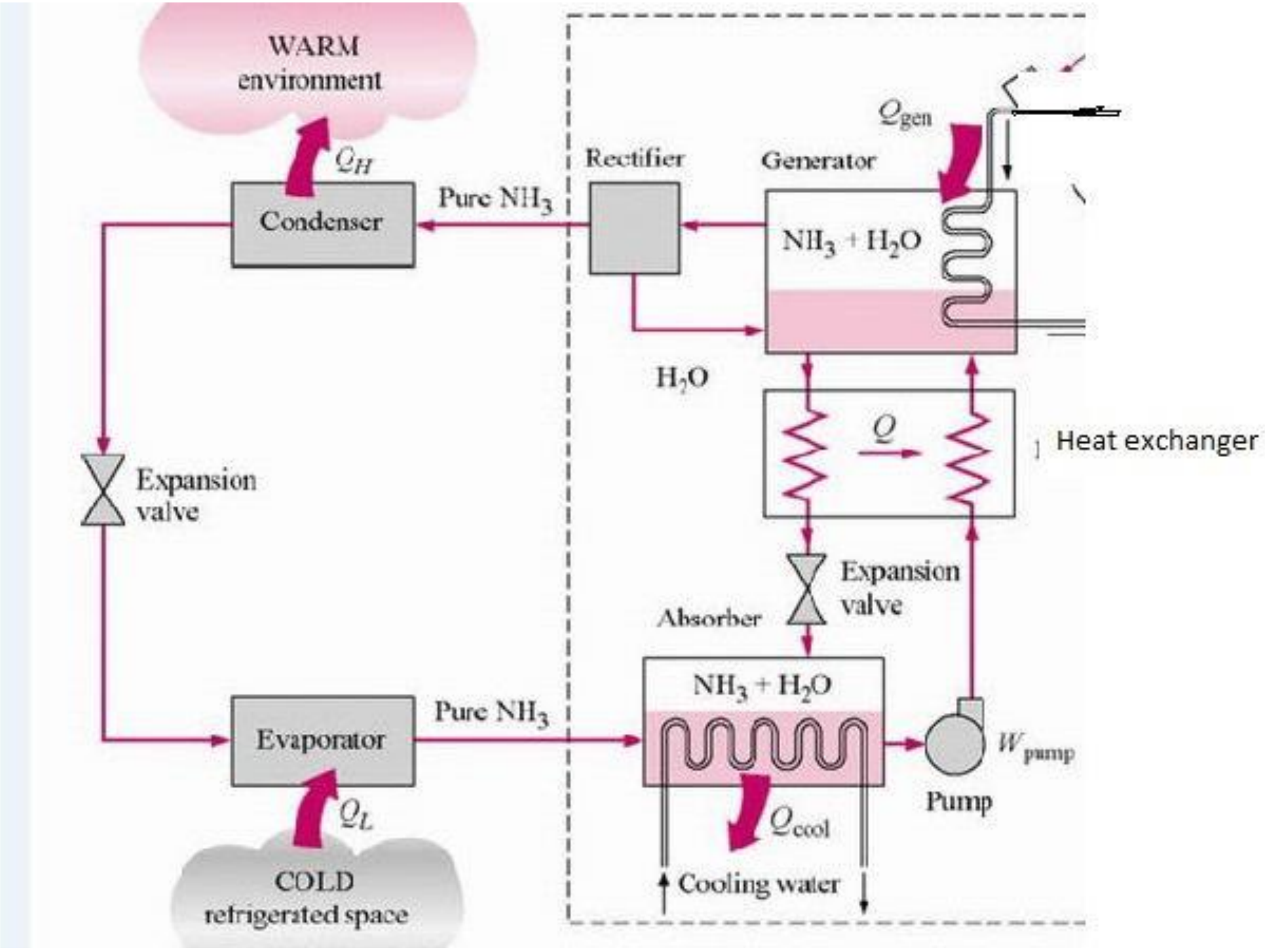
3. High P, High T (More than atmosphere), Vapour -liquid refrigerant

4. High P, low T (More than space), liquid refrigerant



Refrigeration System

Vapour absorption refrigeration system (VARS) - requires negligible/no electricity



Refrigeration System

Differences between Vapour compression refrigeration system (VCRS) and Vapour absorption refrigeration system (VARS)

SL.NO	PRINCIPLE	VAPOR COMPRESSION SYSTEM	VAPOR ABSORPTION SYSTEM
1	WORKING	Refrigerant vapor is compressed	Refrigerant vapor is absorbed & heated
2	TYPE OF ENERGY SUPLIED	Works on mechanical energy	Works on heat energy
3	COP	Higher	Lower
4	CAPACITY	can produce upto 1000 TOR	Can produce more than 1000 TOR
5	NOISE	More due to presence of compressor	Quiet in operation as there is no compressor
6	LEAKAGE	Due to high pressures, the chance of leakage of refrigerant is more	There is no leakage of the refrigerant
7	MAINTENANCE	High	Less
8	OPERATING COST	High, since electrical energy is used	Less because the thermal energy can be supplied from various sources

Refrigeration & Air condition (R & AC)

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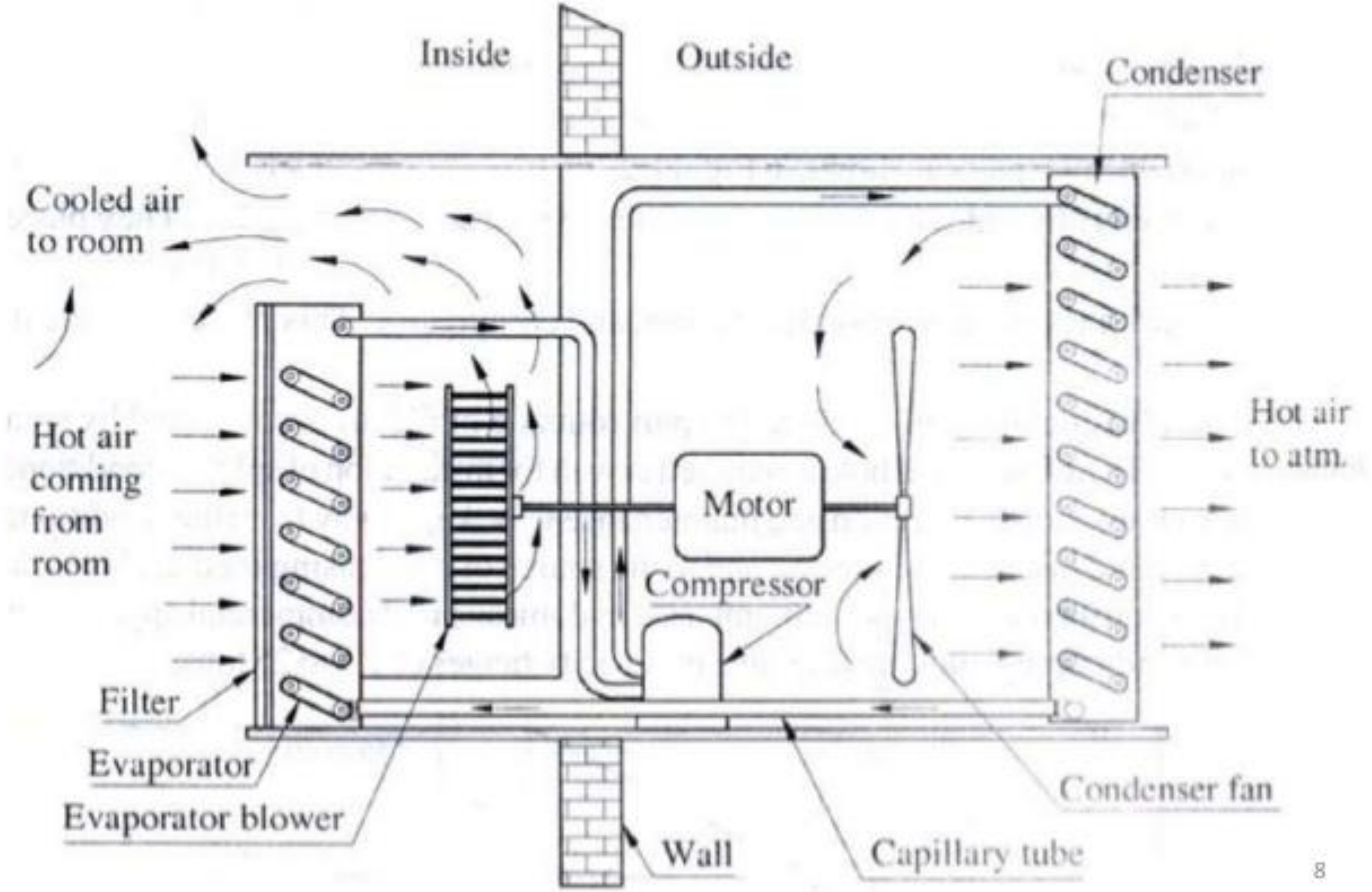
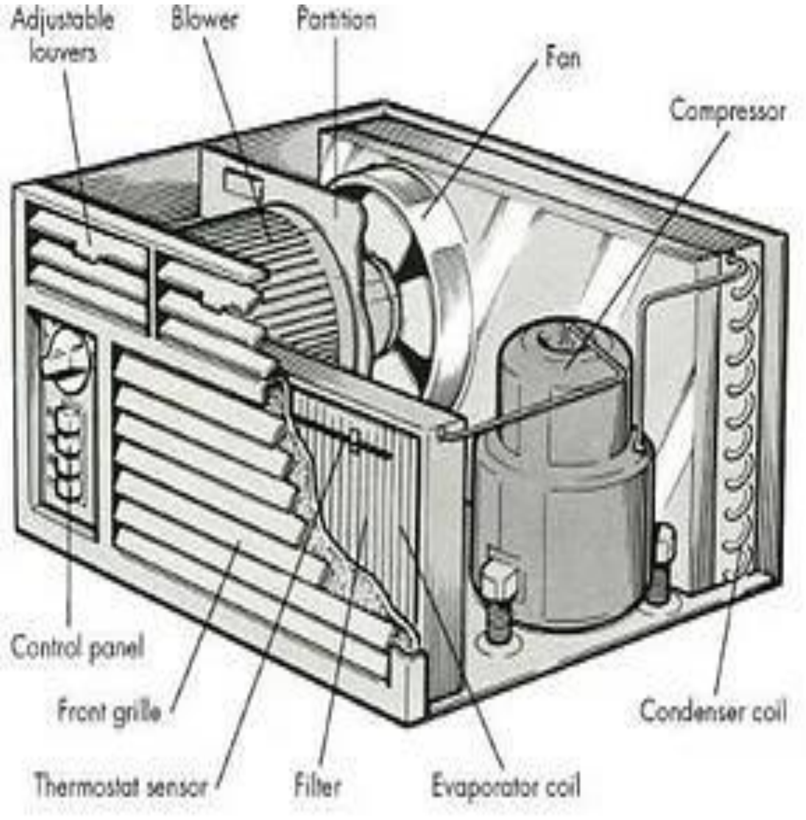
Refrigeration System

Window (Room) Air condition system





Refrigeration System

Refrigeration effect: in a refrigeration system, the rate at which the heat is absorbed in a cycle from the interior space to be cooled is called refrigerating effect.

Ton of refrigeration or Ice making capacity: a ton of refrigeration is defined as the quantity of heat absorbed in order to form one ton of ice in 24 hours when the initial temperature of the water is $0^{o}C$.

1 TON of refrigeration = 210 KJ/min = 3.5 KW

Coefficient of performance (COP): The COP of a refrigeration system is defined as the ratio of heat absorbed in a system to the work supplied.

If Q= Heat absorbed or removed, KW, W= work supplied, KW

COP = Q/W

Humidity: The amount of moisture present in the air

Relative humidity = $\frac{Amount\ of\ moisture\ present\ in\ air\ at\ certain\ temprature}{Maximum\ amount\ of\ moisture\ can\ held\ by\ at\ at\ same\ temprature}$