This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œUnits of Refrigeration â€“ 1â€�.

1. At what K is the triple point of water?
a) 0 K
b) 4 K
c) 273.16 K
d) -273.16

Answer: c
Explanation: At 273.16 K, i.e. 0C water contains all the three forms, solid, liquid as well as gas partially.

2. What is the relation between Celsius and Fahrenheit scale?
a) $\frac{C}{9} = \frac{F-32}{5}$
b) $\frac{C}{5} = \frac{F-32}{9}$
c) $\frac{C}{32} = \frac{F-32}{5}$
d) $\frac{C}{5} = \frac{F-9}{32}$

Answer: b
Explanation: It is derived by using the following relation, $\frac{C}{100} = \frac{F-32}{180}$ because, in the scale developed by Fahrenheit in 1742, the freezing point of water was at 32 and boiling was at 212, i.e. 180 points difference, Whereas for Celsius scale the difference is 100 units (0C to 100C).

3. What does 298 Kelvin mean on Celsius scale?
a) 27 C
b) 25 C
c) 15 C
d) 35 C

Answer: b
Explanation: As for conversion of Kelvin to Celsius 273 is to be deducted, hence 298 K = 298 â€“ 273 = 25C.

4. What is the value of 110 C on the Fahrenheit scale?
a) 198 F
b) 383 F
c) â€“ 73 F
d) 230 F

Answer: d
Explanation: According to the relation, $\frac{C}{5} = \frac{F-32}{9}$
$\frac{110}{5} = \frac{F-32}{9}$
F-32 = 198
F = 230 F.

5. 1 Pascal = 1 _____
a) N/mm^2
b) N/m^3
c) N/m^2
d) N/mm^3

Answer: c
Explanation: Pascal is the unit generally used to express pressure, which means the amount of pressure in Newton, divided by the area i.e. square meters.

6. 1 Bar = ______
a) 1Ã—10^5 N/m^2
b) 1Ã—10^9 N/m^2
c) 1Ã—10^5 N/mm^2
d) 1Ã—10^6 N/m^2

Answer: a
Explanation: Bar is the unit used for expressing the higher level of pressure, which means 760 mm of Hg at the sea level, which equals to 100,000 Newton.

7. 1 Bar = ______ mm of Hg.
a) 100
b) 720
c) 760
d) 360

Answer: c

Explanation: Sometimes pressure is represented in the form of height of mercury in the tube of 1 mm^2 area, i.e. 760 mm practically for 1 bar pressure.

8. What is absolute zero temperature?
a) 0 C
b) 273 C
c) -273 K
d) -273 C

Answer: d
Explanation: Temperature of -273 C i.e. 0 K is called absolute zero temperature, as itâ€™s not possible to go beyond that temperature on the earth.

9. What are the temperature and pressure for S.T.P. (Standard Temperature Pressure)?
a) 0 C, 1 bar
b) 273 C, 15 bar
c) 288 K, 1 bar
d) 273 K, 1 bar

Answer: c
Explanation: Generally, 15 C is taken as the standard temperature, i.e. 288 K and pressure is 760 mm of Hg or 1 bar.

10. What are the temperature and pressure for N.T.P. (Normal Temperature Pressure)?
a) 0 C, 1 bar
b) 273 C, 15 bar
c) 288 K, 1 bar
d) 273 K, 1 bar

Answer: a
Explanation: Generally, 0 C is taken as the standard temperature, i.e. -273 K and pressure is 760 mm of hg or 1 bar.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œOpen Air Refrigeration System â€“ 1â€�.

1. Which of the following can be called as a refrigeration process?
a) Cooling of hot ingot from 1000 C to room temperature
b) Cooling of a pot of water by mixing it with a large block of ice
c) Cooling in rooms using a ceiling fan
d) Cooling of hot water by mixing it with tap water

Answer: b
Explanation: Refrigeration is the process of cooling the body with the help of evaporation during the contact with the other external surface, hence when Ice mixes with water, the water in pot will suddenly drop its temperature whereas the Ice will be converted liquid and evaporate (invisibly).

2. What is the main disadvantage of natural refrigeration methods?
a) They are expensive
b) They are poisonous
c) They are not environment friendly
d) They are dependent on local conditions

Answer: d
Explanation: Natural Refrigeration process is dependent on the local conditions like temperature of surrounding, pressure at which it occurs, and volume of the refrigerant etc. hence it cannot be predicted exactly.

3. For what condition, evaporative cooling system is ideal?
a) Hot and Dry
b) Hot and Humid
c) Cold and Humid
d) Moderate Hot but Humid

Answer: a
Explanation: As the humidity increases, it becomes difficult to produce refrigeration effect as there increases the need to set up a de-humidifier too.

4. Compared to natural refrigeration methods, artificial refrigeration methods are________
a) dis-continuous
b) not reliable
c) continuous
d) environment friendly

Answer: c
Explanation: As artificial refrigeration uses various refrigerants like R-12,R-14,R-150 etc. along with CFC it becomes harmful for environment, but it produces a constant cooling whenever required.

5. What is the main function of an expansion valve?
a) Reduce the refrigerant pressure
b) Maintain high and low side pressures
c) Protect evaporator
d) Control the velocity of flow of refrigerants

Answer: b
Explanation: Expansion valve mainly increases or decreases the flow of refrigerants, which directly affects the increase and decrease in the pressures.

6. In a domestic icebox type refrigerator, the ice block is kept at the top because ___________
a) it is easy for the user to operate
b) disposal of water is easier
c) hot air can be easily removed from the top
d) cold air can flow down due to buoyancy effect

Answer: d
Explanation: Buoyancy effect acts similar to the gravitational force that occurs on the surface outside, hence the more dense cold air comes to the bottom and the hot air goes at the top, but there is no chance of hot air in the refrigerator.

7. Why are vapour absorption system better than compression system?
a) Uses low grade thermal energy
b) Uses no energy
c) Uses refined petroleum energy to produce least pollution
d) Uses high grade thermal energy

Answer: a
Explanation: It uses low grade of thermal energy, hence it can easily be operated for greater output, and economically.

8. In a triple fluid vapour absorption refrigeration system, why is the hydrogen gas used?
a) Improve system performance
b) Reduce the partial pressure of vapour in the evaporator
c) Calculate the refrigerant
d) Provide the vapour seal

Answer: b
Explanation: Hydrogen gas is lighter and less dense than many of the gases. Hence it is used to reduce the partial pressure in the vapour in the evaporator.

9. Why low temperature refrigeration is produced in an air standard refrigeration system?
a) Evaporation of liquid air
b) Throttling of air
c) Expansion of air in turbine
d) Condensing of air

Answer: c
Explanation: Due to expansion of air in turbines, the pressure in the air decreases and the loss of pressure results in the fall of temperature. Hence low temperature is obtained in air standard refrigeration system.

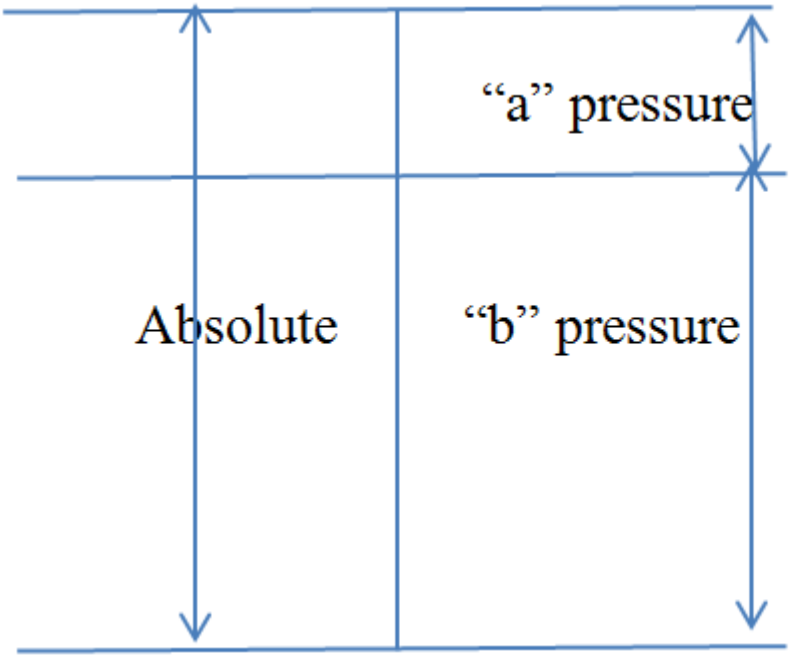
10. The required input to the steam jet refrigeration systems is in the form of?
a) Mechanical energy
b) Thermal energy

c) High pressure, motive steam
d) Both mechanical and thermal

Answer: c
Explanation: For a Steam jet refrigeration, the velocity at input is an important part to produce the Jet effect. Hence the input pressure must be high enough as possible.

This set of Refrigeration Interview Questions and Answers focuses on â€œUnits of Refrigeration â€“ 2â€�.

1. What are the pressure in the places at â€œaâ€� and â€œbâ€� respectively in the given graph?



a) Gauge, Absolute
b) Absolute, Gauge
c) Atmospheric, Gauge
d) Gauge, Atmospheric
Answer: d
Explanation: Absolute pressure is the sum of Gauge pressure and Atmospheric pressure. Also, Atmospheric pressure is measured from the datum level and Gauge pressure starts above the Atmospheric pressure.

2. What does 1 Tonne (TR) in refrigeration mean?
a) Weight of gases
b) Weight of coolant
c) Capacity of 1 tonne air to be cooled to 0 C in 24 hours
d) Capacity of 1 tonne water to be cooled to 0 C in 24 hours

Answer: d
Explanation: 1 Tonne Rating (TR) means that the capacity is such that it can convert 1 tonne of water to ice i.e. 0C in 24 hours.

3. 1 Tonne = ______ KJ/s.
a) 2.67
b) 1.087
c) 3.5
d) 232.6

Answer: c
Explanation: 1TR = 1000 Ã— 335 KJ in 24 hours
= \(\frac{1000 Ã— 335}{24 Ã— 60}\) KJ/min
= 232.6 KJ/min = 210 KJ/min (practically taken)
= 3.5 KJ/s.

4. Which is the S.I. unit to measure pressure in refrigeration?
a) Newton
b) Joule
c) Pascal
d) Bar

Answer: c
Explanation: Generally, unit like N/mm^2, N/m^2, KN/mm^2 and MN/mm^2 etc. are used but the S.I. unit used is N/m^2 i.e. Pascal.

5. 0 Kelvin = ____ Celsius.
a) -273 C
b) 273 C
c) -273 K
d) 0 C

Answer: a
Explanation: As for Temperature 273 K= 0 C, i.e. 0 K = -273 C from the temperature scale developed by Celsius.

6. The heat removing capacity of one tonne refrigeration is equal to?
a) 210 KJ/min
b) 620 KJ/min
c) 240 KJ/min
d) 430 KJ/min

Answer: a
Explanation: 1TR = 1000 kg Ã— 335 KJ (Latent heat of Ice) in 24 hours
= \(\frac{1000 Ã— 335}{24 Ã— 60}\) KJ/min
= 232.6 KJ/min
= 210 KJ/min (practically taken).

7. What does 35 Celsius (C) mean on Kelvin scale (K)?
a) 350
b) 135
c) 308
d) 298

Answer: c
Explanation: For conversion of a unit from Celsius to Kelvin, 273 is to added, i.e. 35 + 273 = 308 K (here).

8. What is S.I. unit of refrigeration?
a) J/min
b) KJ/s
c) KWh
d) Kg/s

Answer: b
Explanation: KJ/s or KW is the S.I. unit of refrigeration, which is converted to Tonnes as commercial unit.

9. 1 N/mm ^{2} = _____ mm of Hg (mercury).
a) 1
b) 256
c) 760
d) 720

Answer: c
Explanation: 1 N/mm ^{2} is also called 1 Pascal which is a measure of pressure. Hence to measure 1 Pascal of pressure the height of mercury found out practically was 760 mm. So 1 N/mm ^{2} = 760 mm of Hg.

10. What is the S.I. unit required to measure the work done in refrigeration is?
a) Joule/kg
b) KJ/kg
c) Joule/m. s
d) Joule/s

Answer: d
Explanation: The S.I. unit of Work done is Watt, i.e. Joule/Second. That means the amount of energy required in joules for unit time.

This set of Refrigeration Questions and Answers for Freshers focuses on â€œCoefficient of Performance of Refrigeration â€“ 2â€�.

1. Efficiency of the Refrigerator is _________ to the C.O.P of refrigerator.
a) inversely proportional
b) equal
c) independent
d) directly proportional

Answer: c
Explanation: Efficiency is the ratio of work done to heat supplied, whereas C.O.P is the ratio of Refrigeration effect to work done. Hence it is totally independent quantity.

2. What is the C.O.P. of a refrigeration system if the work input is 40 KJ/kg and work output is 80 KJ/kg and refrigeration effect produced is 130 KJ/kg of refrigerant flowing.
a) 3.00
b) 3.25
c) 2.25
d) 3.75

Answer: b
Explanation: C.O.P. = \(\frac{Refrigeration \,effect}{Work \,Done \,(Output-Input)}\)
= \(\frac{130}{80-40}\)
= 3.25 (unit less).

3. Find the Relative C.O.P. of a refrigeration system if the work input is 100 KJ/kg and refrigeration effect produced is 250 KJ/kg of refrigerant flowing. Also Theoretical C.O.P. is 3.
a) 0.65
b) 0.80
c) 0.83
d) 0.91

Answer: c
Explanation: Actual C.O.P. = \(\frac{Refrigeration \,effect}{Work \,Done}\)
= \(\frac{250}{100}\)
= 2.5 (unit less)
Relative C.O.P. = \(\frac{Actual \,C.O.P.}{Theoretical \,C.O.P.}\)
= \(\frac{2.5}{3}\) = 0.833 i.e. = 83.3 %.

4. If a condenser and evaporator temperatures are 225 K and 100 K respectively, then reverse Carnot C.O.P is _________
a) 0.5
b) 1.5
c) 1.25

d) 1.75

Answer: c
Explanation: Reverse Carnot C.O.P. = \(\frac{t2-t1}{t1}\)
= \(\frac{225-100}{100}\)
= 1.25.

5. If a condenser and evaporator temperatures are 312 K and X K respectively, and C.O.P. is given as 5 then find the value of X.
a) 52
b) 65
c) 78
d) 82

Answer: a
Explanation: Reverse Carnot C.O.P. = \(\frac{t2-t1}{t1}\)
5 = \(\frac{312-X}{X}\)
6X = 312
X = 52 K.

6. The C.O.P for reverse Carnot refrigerator is 6. The ratio of lowest temperature to highest temperature will be ______
a) twice
b) three times
c) four times
d) seven times

Answer: d
Explanation: Reverse Carnot C.O.P. = \(\frac{t2-t1}{t1}\)
6 = \(\frac{X-Y}{Y}\)
6 = \(\frac{X}{Y}\) â€“ 1
Thus, \(\frac{X}{Y}\) = 7 i.e. X=7Y i.e. Higher temperature = 7 times Lower temperature.

7. In general the ratio of lowest to highest temperature with respect to C.O.P. can be denoted by __________
a) C.O.P + 1 = Ratio of temperature
b) C.O.P/2 = Ratio of temperature
c) C.O.P + 4 = Ratio of temperature
d) C.O.P + 2 = Ratio of temperature

Answer: a
Explanation: In general, the ratio of lowest to highest temperature, say \(\frac{X-Y}{Y}\) = C.O.P. Hence, \(\frac{X}{Y}\) â€“ 1 = C.O.P. i.e. \(\frac{X}{Y}\) = C.O.P + 1.

8. The C.O.P for reverse Carnot refrigerator is 2. The ratio of highest temperature to lowest temperature will be ______
a) 4 times
b) 3 times
c) 1/2 times
d) 1/3 times

Answer: d
Explanation: Reverse Carnot C.O.P. = \(\frac{t2-t1}{t1}\)
2 = \(\frac{X-Y}{Y}\)
2 = \(\frac{X}{Y}\) â€“ 1
Thus, \(\frac{X}{Y}\) = 3 i.e. X=3Y i.e. Lowest temperature = \(\frac{1}{3}\) times Highest temperature.

9. The C.O.P of a reverse Carnot cycle doesnâ€™t depend on which of the following?
a) Moisture
b) Evaporator temperature
c) Condenser temperature
d) Work done

Answer: a
Explanation: C.O.P for a reverse Carnot depends directly on the difference of Evaporator and Condenser temperature, and inversely on the Work done.

10. If a condenser and evaporator temperatures are â€˜Xâ€™ K and 100 K respectively, and reverse Carnot C.O.P is 2.5 then find out the â€˜Xâ€™.

a) 100 K
b) 150 K
c) 350 K
d) 200 K

Answer: c
Explanation: Reverse Carnot C.O.P. = $\frac{t2-t1}{t1}$
2.5 = $\frac{X-100}{100}$
X = 350 K.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œCoefficient of Performance of Refrigeration â€“ 1â€�.

1. What is the term C.O.P. referred in terms of refrigeration?
a) Capacity of Performance
b) Co-efficient of Plant
c) Co-efficient of Performance
d) Cooling for Performance

Answer: c
Explanation: Co-efficient of Performance is generally referred as C.O.P. for Refrigeration, which is used to measure the capacity or level up to which the refrigeration will occur.

2. C.O.P. can be expressed by which equation?
a) $\frac{Work \,Done}{Refrigeration \,effect}$
b) $\frac{Refrigeration \,effect}{Work \,Done}$
c) $\frac{Work\, Done}{Heat \,Transfer}$
d) $\frac{Heat \,Transfer}{Work \,Done}$

Answer: b
Explanation: Co-efficient of Performance is the ratio of the Refrigeration effect produced to the work done or work supplied to produce the effect.
Whereas the ratio- Work done to Heat transfer is called the efficiency.

3. What is the term relative C.O.P. referred in terms of refrigeration?
a) $\frac{Actual \,C.O.P.}{Theoretical \,C.O.P.}$
b) $\frac{Theoretical \,C.O.P.}{Actual \,C.O.P.}$
c) $\frac{Actual \,C.O.P.}{Average \,C.O.P.}$
d) $\frac{Average \,C.O.P.}{Theoretical \,C.O.P.}$

Answer: a
Explanation: Relative Co-efficient of Performance is generally referred as the ratio of Actual C.O.P. measured to the Theoretical C.O.P. assumed before calculations. It is in relation with the theoretical C.O.P. and generally expressed in â€œ%â€� value.

4. Find the C.O.P. of a refrigeration system if the work input is 40 KJ/kg and refrigeration effect produced is 130 KJ/kg of refrigerant flowing.
a) 3.00
b) 2.25
c) 3.75
d) 3.25

Answer: d
Explanation: Here, refrigeration effect = 130 KJ/kg, work input = 40 KJ/kg
C.O.P. = $\frac{Refrigeration \,effect}{Work \,Done}$
= $\frac{130}{40}$
= 3.25 (unit less).

5. Find the Relative C.O.P. of a refrigeration system if the work input is 60 KJ/kg and refrigeration effect produced is 130 KJ/kg of refrigerant flowing. Also Theoretical C.O.P. is 3.
a) 0.65
b) 0.79
c) 0.72
d) 0.89

Answer: c
Explanation: Given, work input = 60 KJ/kg, refrigeration effect = 130 KJ/kg and Theoretical C.O.P. = 3
Actual C.O.P. = $\frac{Refrigeration \,effect}{Work \,Done}$

= $\frac{130}{60}$
= 2.167 (unit less)
Relative C.O.P. = $\frac{Actual \,C.O.P.}{Theoretical \,C.O.P.}$
= 2.167/3 = 0.722 i.e. = 72.2 %.

6. Find the C.O.P. of a refrigeration system if the work input is 30 KJ/kg and refrigeration effect produced is 120 KJ/kg of refrigerant flowing.
a) 3.00
b) 4.00
c) 0.75
d) 0.25

Answer: b
Explanation: Given, work input = 30 KJ/kg and refrigeration effect = 120 KJ/kg
C.O.P. = $\frac{Refrigeration \,effect}{Work \,Done}$
= $\frac{120}{30}$
= 4 (unit less).

7. Which equation represents efficiency in general?
a) $\frac{Work \,Done}{Refrigeration \,effect}$
b) $\frac{Heat \,Trasfer}{Work \,Done}$
c) $\frac{Work\, Done}{Heat \,Transfer}$
d) $\frac{Refrigeration \,effect}{Work \,Done}$

Answer: c
Explanation: Work done to Heat transfer is called the efficiency in general sense, which can be applicable to Pumps, Refrigerators, and Turbines etc.
Whereas Co-efficient of Performance is the ratio of Refrigeration effect produced to the work done or work supplied to produce the effect.

8. The Co-efficient of Performance is always ___________
a) greater than 1
b) less than 1
c) equal to 1
d) zero

Answer: a
Explanation: C.O.P. is always greater than 1, because in the ratio of C.O.P. the Refrigeration effect is always greater than the work done.

9. In a refrigerating machine, if the lower temperature is fixed, then the C.O.P. of machine can be increased by?
a) Increasing the higher temperature
b) Decreasing the higher temperature
c) Operating the machine at lower speed
d) Operating the machine at higher speed

Answer: b
Explanation: By decreasing the higher temperature, the change in temperatures can be reduced. This directly reduces the word done i.e. the denominator in C.O.P. Hence the C.O.P increases.

10. The reverse Carnot cycle C.O.P. can be expressed as __________ (Where t1 is the lower temperature and t2 is the higher temperature).
a) $\frac{t1-t2}{t2}$
b) $\frac{t2-t1}{t2}$
c) $\frac{t2-t1}{t1-t2}$
d) $\frac{t2-t1}{t1}$

Answer: d
Explanation: Reverse Carnot C.O.P is the ratio of change in temperature i.e. t2-t1 to the lower temperature i.e. t1 here.

11. If a condenser and evaporator temperatures are 120 K and 60 K respectively, then reverse Carnot C.O.P is __________
a) 0.5
b) 1
c) 3
d) 2

Answer: b
Explanation: Reverse Carnot C.O.P. = $\frac{t2-t1}{t1}$
= $\frac{120-60}{60}$
= 1.

12. The C.O.P. of reverse Carnot cycle is most strongly dependent on which of the following?
a) Evaporator temperature
b) Condenser temperature
c) Specific heat
d) Refrigerant

Answer: a
Explanation: The C.O.P in the reverse Carnot cycle generally depends on the higher of the two temperatures, as it is located in the numerator of C.O.P equation and responsible directly for increase or decrease in C.O.P.

13. If a condenser and evaporator temperatures are 312 K and 273 K respectively, then reverse Carnot C.O.P is __________
a) $\frac{1}{5}$
b) $\frac{1}{6}$
c) $\frac{1}{7}$
d) $\frac{1}{8}$

Answer: c
Explanation: Reverse Carnot C.O.P. = $\frac{t2-t1}{t1}$
= $\frac{312-271}{273}$
= $\frac{1}{7}$.

14. The C.O.P for reverse Carnot refrigerator is 2. The ratio of lowest temperature to highest temperature will be ______
a) twice
b) half
c) four times
d) three times

Answer: d
Explanation: Reverse Carnot C.O.P. = $\frac{t2-t1}{t1}$
2 = $\frac{X-Y}{Y}$
2 = $\frac{X}{Y}$ â€“ 1
Thus, $\frac{X}{Y}$ = 3 i.e. X=3Y i.e. Higher temperature = 3 times Lower temperature.

15. If a condenser and evaporator temperatures are 250 K and 100 K respectively, then reverse Carnot C.O.P is __________
a) 5.5
b) 1.5
c) 2.5
d) 3.0

Answer: b
Explanation: Reverse Carnot C.O.P. = $\frac{t2-t1}{t1}$
= $\frac{250-100}{100}$
= 1.5

This set of Refrigeration Interview Questions and Answers for freshers focuses on â€œOpen Air Refrigeration System â€“ 2â€�.

1. What is the common application of Air standard refrigeration system?
a) Domestic refrigerators
b) Aircraft air conditioning
c) Cold storage
d) Car air conditioning system

Answer: b
Explanation: As sufficient amount of air is obtained while aviation of air crafts, the only thing is to reduce its velocity, and then it can be used for air conditioning in air crafts.

2. Why is a nozzle used in a steam jet refrigeration system?
a) To convert the high pressure motive steam into high velocity steam
b) To reduce energy consumption

c) To improve safety aspects
d) To improve thermal conductivity

Answer: a
Explanation: Nozzle is a device which has one of its end converging whereas the other end diverging, when the steam enters from larger end and exit at smaller end, its velocity increases that produces Jet effect. Hence nozzle is used for it.

3. Which properties are essential for thermoelectric refrigeration?
a) High electrical and thermal conductivity
b) Low electrical and thermal conductivity
c) Low electrical conductivity and high thermal conductivity
d) High electrical conductivity and low thermal conductivity

Answer: d
Explanation: For producing thermoelectric effect, high thermal conductivity is a desirable property, but for producing refrigerating effect the thermal conductivity should be lowest to reduce the loss of cooling due to conduction through walls.

4. Why is fast freezing done in various products ?
a) To reduce the cell damage due to ice crystal growth.
b) To reduce energy consumption of refrigerator
c) To reduce the bacterial activity
d) To save time

Answer: a
Explanation: If the refrigeration in allowed to occur at a slow rate, the cells may get damage due to ice formation in the form of crystals because of the moisture content present in it.

5. In a refrigerating machine, heat rejected is ________ the heat absorbed.
a) equal to
b) less than
c) in unity with
d) greater than

Answer: d
Explanation: Heat rejected in refrigerating machine is always more than the heat absorbed because as the evaporation increases i.e. heat rejection, more will be the refrigerating effect.

6. What is NOT one of the advantages of using closed Air Refrigeration system?
a) Lighter in weight
b) Compact in construction
c) Environmental Friendly
d) Lower co-efficient of performance

Answer: d
Explanation: Air refrigeration system is used mainly due to light in weight, smaller and environment friendly due to use of air as refrigerant. Also it has higher co-efficient of performance.

7. Reduction in operating pressure in the Air refrigeration cycle results in _________
a) increase in C.O.P.
b) decrease in C.O.P.
c) no change in C.O.P.
d) always decreases

Answer: a
Explanation: As the operating pressure reduces, the change in work done decreases. Hence the C.O.P of refrigeration increases.

8. How is the refrigerant used in the Air refrigeration cycle?
a) In the condenser
b) In the compressor
c) Directly in contact
d) Not used at all

Answer: c
Explanation: Refrigerant used in Air refrigeration cycle is pure air, and itâ€™s used directly in contact with the area of refrigeration. Whereas in Expansion refrigeration, refrigerants are used in condensers etc.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œVapour Refrigeration Cycles â€“ Heat Pumpâ€�.

1. For a standard system with temperatures T_1 and T_2, where $T_1 < T_a < T_2$ (T_a â€“ Atmospheric Temperature). Q_1 is the heat extracted from a body at temperature T_1, and Q_2 is heat delivered to the body at temperature T_2. What is the C.O.P. of the heat pump for given conditions?
a) Q_2 / (Q_2 âˆ’ Q_1)
b) (Q_2 âˆ’ Q_1) / Q_1
c) (Q_2 âˆ’ Q_1) / Q_2
d) Q_1 / (Q_2 âˆ’ Q_1)

Answer: a
Explanation: As, C.O.P. = Desired effect / Work done
Here, work-done = Q_2 âˆ’ Q_1
The desired temperature is T_2. So, the heat delivered to achieve the desired temperature is Q_2.
C.O.P. of the heat pump = Q_2 / (Q_2 âˆ’ Q_1).

2. What is the difference between Heat Pump and Refrigerator?
a) Heat Pump Gives efficiency and refrigerator gives C.O.P.
b) Both are similar
c) Both are almost similar, just the desired effect is different
d) Work is output in refrigerator and work is input in heat pump

Answer: c
Explanation: Heat Pump and Refrigerator work on the same principle. Work needs to be given to get the desired effect. The characteristic which differentiates both of them is the temperature of the desired effect, heat pump desires for higher temperature whereas Refrigerator desires for lower temperature than atmospheric temperature.

3. What is the equation between efficiency of Heat engine and C.O.P. of heat pump?
a) Î·$_E$ = (C.O.P.)$_P$
b) Î·$_E$ = 1 / (C.O.P.)$_P$
c) Î·$_E$ / (C.O.P.)$_P$ = 1
d) Î·$_E$ x (C.O.P.)$_P$ = 0

Answer: b
Explanation: Î·$_E$ = W / Q hence for Carnot engine it is equal to (T_2 â€“ T_1) / T_2.
(C.O.P.)$_P$ for Carnot cycle is equal to T_2 / (T_2 â€“ T_1).
So, these terms are related reciprocally.

4. How is the Relative coefficient of performance represented?
a) Theoretical C.O.P. / Actual C.O.P.
b) Actual C.O.P. / Theoretical C.O.P.
c) Theoretical C.O.P. x Actual C.O.P.
d) 1 / Theoretical C.O.P. x Actual C.O.P.

Answer: b
Explanation: Relative C.O.P. is the ratio of an actual to the theoretical coefficient of performance. It is used to show the deviation of C.O.P. due to the ideal state and real state conditions.

5. C.O.P. of the heat pump is always _____
a) one
b) less than One
c) greater than One
d) zero

Answer: c
Explanation: The second law of Thermodynamics states that a 100% conversion of heat into work is not possible without ideal conditions. So, efficiency will be less than 1. As C.O.P. is the reciprocal of efficiency, it tends to be more than 1.

6. For the systems working on reversed Carnot cycle, what is the relation between C.O.P. of Refrigerator i.e. (C.O.P.)$_R$ and Heat Pump i.e. (C.O.P)$_P$?

a) (C.O.P.)$_R$ + (C.O.P)$_P$ = 1
b) (C.O.P.)$_R$ = (C.O.P)$_P$
c) (C.O.P.)$_R$ = (C.O.P)$_P$ â€“ 1
d) (C.O.P.)$_R$ + (C.O.P)$_P$ + 1 = 0

Answer: c
Explanation: If we put the values of C.O.P. for standard system i.e. (C.O.P.)$_R$ = T$_1$ / (T$_2$ âˆ’ T$_1$) and
(C.O.P.)$_P$ = T$_2$ / (T$_2$ âˆ’ T$_1$),
(C.O.P.)$_P$ âˆ’ (C.O.P.)$_R$ = 1.
{T$_2$ / (T$_2$ âˆ’ T$_1$)} âˆ’ {T$_1$ / (T$_2$ âˆ’ T$_1$)} = 1.

7. If the reversed Carnot cycle operating as a heat pump between temperature limits of 364 K and 294 K, then what is the value of C.O.P?
a) 4.2
b) 0.19
c) 5.2
d) 0.23

Answer: c
Explanation: C.O.P. of reversed Carnot cycle is given by,
C.O.P. = T$_1$ / (T$_2$ â€“ T$_1$)
= 364 / (364 â€“ 294)
= 5.2.

8. A reversed Carnot cycle is operating between temperature limits of (-) 33Â°C and (+) 27Â°C. If it acts as a heat engine gives an efficiency of 20%. What is the value of C.O.P. of a heat pump operating under the same conditions?
a) 6.5
b) 8
c) 5
d) 2.5

Answer: c
Explanation: Temperature limits are given in the question so, we can calculate C.O.P. using the formula
C.O.P. = T$_1$ / (T$_2$ â€“ T$_1$)
But as the efficiency of the heat engine is given so directly by the relation, we can find out the C.O.P.
C.O.P. = 1 / Î·$_E$
= 1 / (0.2) = 5.

9. If the coefficient of performance of the refrigerator is 4.67, then what is the value of the coefficient of performance of the heat pump operating under the same conditions?
a) 3.67
b) 5.67
c) 0.214
d) 9.34

Answer: b
Explanation: As we know, the equation between the coefficient of performance of the Refrigerator and heat pump:
(C.O.P.)$_R$ = (C.O.P.)$_P$ â€“ 1
Hence, C.O.P. of heat pump = C.O.P. of Refrigerator + 1
= 4.67 + 1
= 5.67.

10. A heat pump is used to maintain a hall at 30Â°C when the atmospheric temperature is 15Â°C. The heat loss from the hall is 1200 kJ/min. Calculate the power required to run the heat pump if its C.O.P. is 40% of the Carnot machine working between the same temperature limits.
a) 0.495
b) 4.04
c) 0.247
d) 8.08

Answer: c
Explanation: Given data: T$_1$ = 30Â°C = 30 + 273 = 303 K

T_2 = 15Â°C = 15 + 273 = 288 K
Q_1 = 1200 kJ/min = 1200/60 = 2 kW
Calculations: C.O.P. of heat pump working on Carnot cycle,
Ideal C.O.P. = T_1 / (T_1 âˆ' T_2)
= 303 / (303 âˆ' 288)
= 20.2
Actual C.O.P = 0.4 x Ideal C.O.P.
= 0.4 x 20.2 = 8.08
C.O.P. = Q_1 / W
Hence, W = Q_1 / C.O.P.
W = 2 / 8.08
W = 0.247 kW.

11. A heat pump which runs (1/3) rd of time removes on an average 2400 kJ/hr of heat. If power consumed is 0.25 kW, what is the value of the C.O.P.?
a) 4
b) 2
c) 8
d) 6

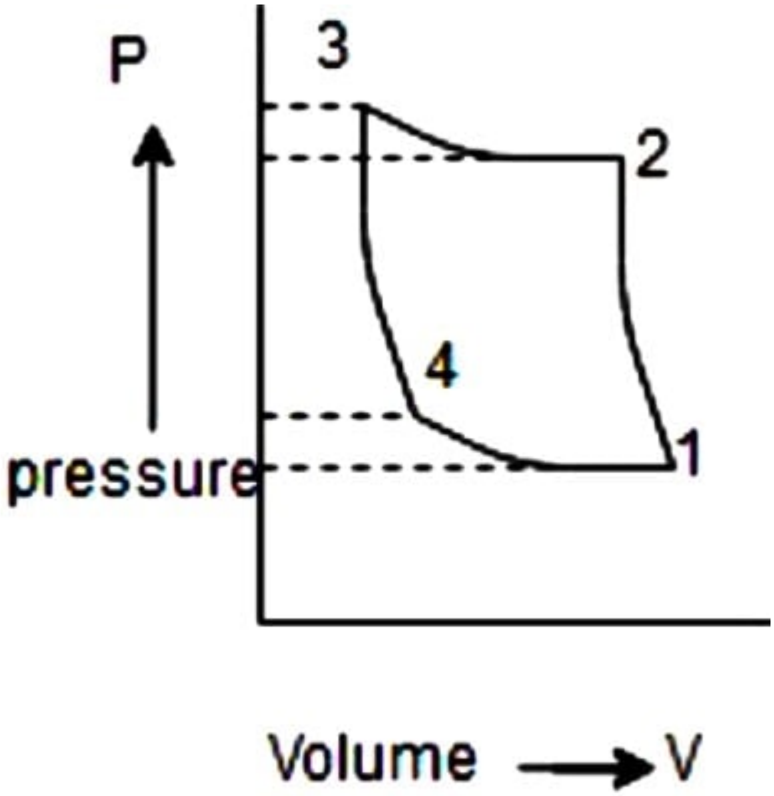
Answer: c
Explanation: Q_1 = 2400 kJ/hr
= 2400 / (3600 / 3)
= 2 kW
C.O.P. = Q_1 / W
= 2 / 0.25
= 8.

12. C.O.P. of the refrigerator is always __________ the C.O.P. of the heat pump when both are working between the same temperature limits.
a) less than
b) greater than
c) equal to
d) inverse of

Answer: a
Explanation: C.O.P. = Desired effect / Work
As the desired effect for the heat pump is higher than the refrigerator. So, numerator value is higher for heat pump keeping denominator constant.
Can also be proved by this equation,
$(C.O.P.)_R$ = $(C.O.P.)_P$ â€“ 1.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œAir Refrigerator Working on Reverse Carnot Cycle â€“ 1â€�.

1. For a refrigerating system that works on reversed Carnot cycle having vapor as refrigerant, which one of the following is not a process of the cycle in p-v diagram?


P
3
2
4
1
pressure
Volume
V

a) Isentropic compression process
b) Isothermal compression process
c) Adiabatic expansion process
d) Isothermal expansion process

Answer: c
Explanation: The reversed Carnot cycle has 4 processes namely, isothermal compression process, isentropic compression process, isentropic expansion process and isothermal expansion process.

2. What is the coefficient of performance of the refrigerant system working on reversed Carnot cycle, having Q_a as heat absorbed by the air during isothermal expansion per kg of air and Q_r as heat rejected during isothermal compression per kg of air?
a) COP=\(\frac{Q_a}{(Q_r â€“ Q_a)}\)
b) COP=\(\frac{Q_r}{(Q_r â€“ Q_a)}\)
c) COP=\(\frac{Q_a}{(Q_r + Q_a)}\)
d) COP=\(\frac{Q_a}{(Q_a â€“ Q_r)}\)

Answer: a
Explanation: COP of refrigerator is COP of heat pump â€“ 1
i.e. \([\frac{Q_r}{Q_r â€“ Q_a}] â€“ 1 = \frac{Q_a}{(Q_r â€“ Q_a)}\).

3. The COP of refrigerator may be improved by __________
a) decreasing the higher (T_2) as well as the lower (T_1) temperature
b) decreasing the higher (T_2) temperature and increasing the lower (T_1) temperature
c) increasing the higher (T_2) as well as the lower (T_1) temperature
d) keeping the higher (T_2) temperature the same while decreasing the lower (T_1) temperature

Answer: b
Explanation: The COP of refrigerator can be given by :
COP = $\frac{T_1}{(T_2- T_1)}$. Hence by decreasing the higher temperature T_2 or by increasing the lower temperature T_1 the COP may be improved.

4. What happens to the COP of a Carnot refrigerator in summer and in winter?
a) The COP is more in winter
b) The COP is more in summer
c) The COP remains unaffected
d) The COP fluctuates continuously during winter and summer

Answer: a
Explanation: As the higher temperature T_2 will always be lower in winter when compared with that of summer i.e. the temperature of air available of heat rejection will be low, the COP in winter will be higher.

5. A refrigerating machine working on Carnot cycle operates between 300K and 250K. Determine the COP.
a) 5
b) 6
c) 4
d) 10

Answer: a
Explanation: The COP of refrigerating machine is given by
COP = $\frac{T_1}{(T_2- T_1)} = \frac{250}{(300-250)}$=5.

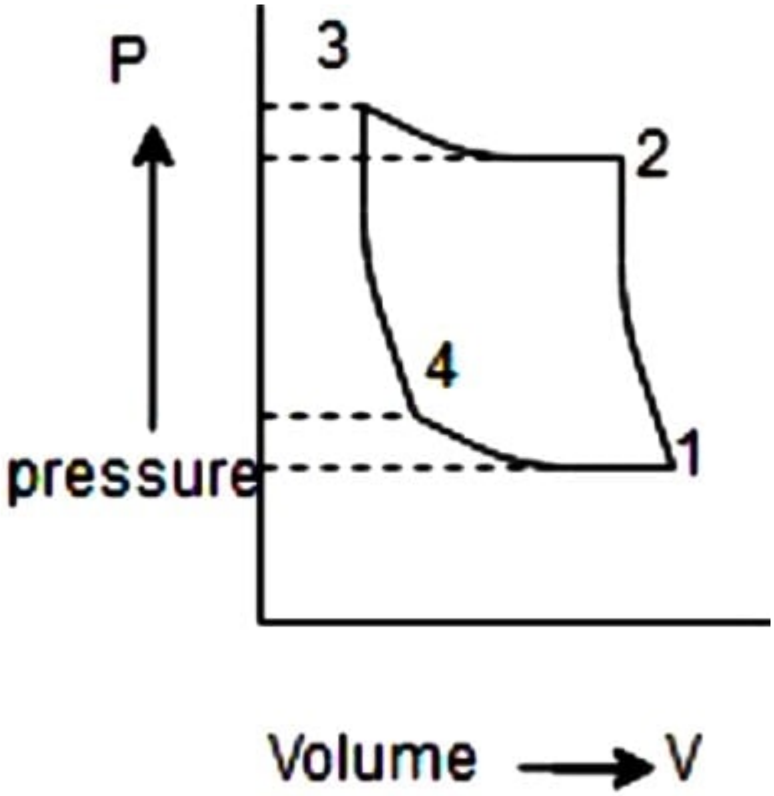
6. The COP_r of a Carnot refrigerating machine is 7.89. What will be the COP_p of heat pump?
a) 10.3
b) 7.89
c) 8.89
d) 6.89

Answer: c
Explanation: Relation between COP of heat pump and COP of the refrigerating machine is
$COP_r = COP_p -1$
$7.89 = COP_p -1$
$COP_p =7.89+1=8.89$.

7. Which one is not a limitation of the Carnot cycle with air or gas as refrigerant?
a) It has low efficiency when working between two fixed temperature limits
b) Machine has to run at high and low speeds during adiabatic and isothermal process. Such variation of speed is not possible
c) Extreme pressure and large volume are developed
d) It is not possible to carry out isothermal heat transfer process in practice

Answer: a
Explanation: Carnot cycle has the highest efficiency theoretically when working between two fixed temperature limits. Other limitations of Carnot cycle are machine has to run at high and low speeds during adiabatic and isothermal process. Such variation of speed is not possible, extreme pressure and large volume is developed, it is not possible to carry out isothermal heat transfer process in practice.

8. For a refrigerating system that works on Carnot cycle having air or gas as refrigerant s, which one of the following is not a process of the cycle in p-v diagram?


P
3
2
4
1
pressure
Volume
V

a) Adiabatic compression process
b) Isothermal compression process
c) Adiabatic expansion process
d) Isentropic expansion process

Answer: d
Explanation: The Carnot cycle having air or gas as refrigerant has 4 processes namely isothermal compression process, adiabatic compression process, isothermal expansion process and adiabatic expansion process.

9. What is the COP of a refrigerator when itâ€™s refrigerating effect R is 6.2755 KW and work consumed is 0.82 KW?
a) 8.8
b) 6.77
c) 7.65
d) 8.56

Answer: c
Explanation: COP of refrigerator = Refrigeration effect / work consumed
COP=$\frac{R}{wc}=\frac{6.2755}{0.82}$=7.65.

10. Out of the following reasons which one is responsible for Carnot cycle not being used in practice?
a) It gives low COP

b) It gives high refrigeration effect
c) It gives low refrigeration effect
d) It has low theoretical efficiency

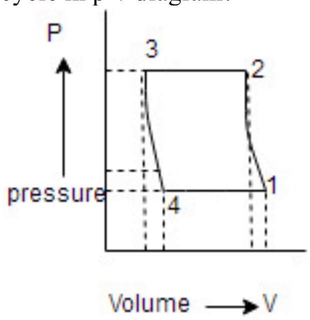
Answer: c
Explanation: Carnot cycle is not used in everyday practice and one of the many reasons is that because it has low refrigeration effect, even though it has the highest theoretical efficiency and also it is not possible to carry out isothermal heat transfer in practice.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œAir Refrigerator Working on Bell-Coleman Cycleâ€�.

1. Bell-Coleman cycle is also known as _____________
a) Carnot cycle
b) Reversed Brayton or Jouleâ€™s cycle
c) Rankine cycle
d) Otto cycle

Answer: b
Explanation: Bell-Coleman cycle was developed by Bell-Coleman and Light Foot by reversing the Jouleâ€™s air cycle and hence is also known as reversed Brayton or Jouleâ€™s cycle. It was one of the easiest types of refrigerators used in ships for carrying frozen meat.

2. For a refrigerating system that works on Bell-Coleman cycle, which one of the following is not a process of the cycle in p-v diagram?



a) Isentropic compression process
b) Constant pressure cooling process
c) Isothermal expansion process
d) Constant pressure expansion process

Answer: c
Explanation: The Bell-Coleman cycle has 4 processes namely isentropic compression process, constant pressure cooling process, isentropic expansion process and constant pressure expansion process.

3. In transport aviation, the air conditioning systems are based on ______ cycle.
a) Reversed Carnot cycle
b) Reversed Brayton cycle
c) Reversed Jouleâ€™s cycle
d) Otto cycle

Answer: b
Explanation: It is because in vapor-cycle the disadvantage was that due to the leakage loss of fluid it would cause the aircraft to be completely without cooling.

4. Dense air Bell-Coleman refrigerator is preferred than open cycle air refrigerator.
a) True
b) False

Answer: a
Explanation: In open cycle air refrigerator the main drawback is the freezing of the moisture in the air during expansion stroke which is liable to choke up the valves. Hence dense air refrigerator is preferred.

5. Which one of the following is not a true disadvantage of the Bell-Coleman cycle?
a) High running cost
b) Low COP
c) The danger of frosting at the expander valve is more
d) The size of the system is small

Answer: d
Explanation: Mass of air required per ton of refrigeration is large as compared to other systems of refrigeration. Hence the size of the system is large.

6. Which one of the following is not a true advantage of the Bell-Coleman cycle?
a) Air is used a refrigerant which is easily available
b) It is safe as air is non-inflammable
c) Air is nontoxic, non-corrosive and stable
d) Weight of air refrigeration equipment per ton of refrigeration is much more in aircraft than other refrigeration systems

Answer: d
Explanation: Weight of air refrigeration equipment per ton of refrigeration is much less in aircraft than other refrigeration systems. Hence it is light. It is because of air compressor is already available in the air-craft.

7. The Bell-Coleman refrigeration cycle uses _____ as refrigerant.
a) Coolant
b) CO_2
c) Air
d) H_2O

Answer: c
Explanation: The Bell-Coleman refrigeration cycle uses air as refrigerant, as it is easily available, non-inflammable, non-toxic, stable and inert.

This set of Refrigeration Questions and Answers for Experienced people focuses on â€œAir Refrigerator Working on Reverse Carnot Cycle â€“ 2â€�.

1. If a refrigeration system having T_1 and T_2 as lower and higher temperatures respectively then, what is the value of C.O.P of the refrigeration system working on the reversed Carnot cycle?
a) T_2 / (T_2 âˆ’ T_1)
b) (T_2 âˆ’ T_1) / T_1
c) (T_2 âˆ’ T_1) / T_2
d) T_1 / (T_2 âˆ’ T_1)

Answer: d
Explanation: As, C.O.P. = Desired effect / Work done
Here, work-done = Q_1 âˆ’ Q_1
The desired temperature is T_1. So, the heat delivered to achieve the desired temperature is Q_1.
C.O.P. of the heat pump = Q_1 / (Q_2 âˆ’ Q_1).
According to Carnotâ€™s theorem,
C.O.P. = T_1 / (T_2 âˆ’ T_1).

2. In a refrigerating machine working on the reversed Carnot cycle, if the lower temperature is fixed, then what can be done to increase the C.O.P.?
a) Increasing higher temperature
b) Operating machine at higher speed
c) Decreasing higher temperature
d) Operating machine at a lower speed

Answer: c
Explanation: As C.O.P. of the refrigerator working on the Carnot cycle is given by,
C.O.P. = T_1 / (T_2 âˆ’ T_1)

So, If T_1 is fixed, so by decreasing the denominator C.O.P. can be increased. If the higher temperature is reduced then by keeping numerator constant, the denominator decreases and leads to an increase in C.O.P.

3. If the condenser and evaporator temperatures are 320 K and 240 K respectively, then what is the value of the C.O.P.?
a) 0.25
b) 4
c) 0.33
d) 3

Answer: d
Explanation: Given: T_1 = 240 K
T_2 = 320 K
C.O.P. = T_1 / (T_2 âˆ’ T_1)
= 240 / (320 âˆ’ 240)
= 240 / (80)
= 3.

4. The efficiency of Carnot heat engine is 40%. What is the value of C.O.P. of a refrigerator operating on reversed Carnot cycle?
a) 2.5
b) 1.5
c) 4
d) 10

Answer: b
Explanation: Î·$_E$ = 40% = 0.4
C.O.P. of heat pump = 1 / Î·$_E$ = 1 / 0.4 = 2.5
As we know, (C.O.P.)$_R$ = (C.O.P.)$_P$ âˆ’ 1
C.O.P. of refrigerator = 2.5 âˆ’ 1
= 1.5.

5. The C.O.P. of a reversed Carnot refrigerator is 5. What is the ratio of highest temperature to lower temperature?
a) âˆ’1.2
b) 0.8
c) 1.2
d) âˆ’0.8

Answer: c
Explanation: As C.O.P. of the refrigerator working on the Carnot cycle is given by,
C.O.P. = T_1 / (T_2 âˆ’ T_1)
5 = T_1 / (T_2 âˆ’ T_1)
(T_2 âˆ’ T_1) / T_1 = 1 / 5
(T_2 / T_1) âˆ’ (T_1 / T_1) = 0.2
T_2 / T_1 âˆ’ 1 = 0.2
T_2 / T_1 = 1.2.

6. For the systems working on reversed Carnot cycle, what is the relation between C.O.P. of Refrigerator i.e. (C.O.P.)$_R$ and Heat Pump i.e. (C.O.P.)$_P$?
a) (C.O.P.)$_R$ + (C.O.P.)$_P$ = 1
b) (C.O.P.)$_R$ = (C.O.P.)$_P$
c) (C.O.P.)$_R$ = (C.O.P.)$_P$ âˆ’ 1
d) (C.O.P.)$_R$ + (C.O.P.)$_P$ + 1 = 0

Answer: c
Explanation: If we put the values of C.O.P. for standard system i.e. (C.O.P.)$_R$ = T_1 / (T_2 âˆ’ T_1) and
(C.O.P.)$_P$ = T_2 / (T_2 âˆ’ T_1),
(C.O.P.)$_P$ âˆ’ (C.O.P.)$_R$ = 1.
{T_2 / (T_2 âˆ’ T_1)} âˆ’ {T_1 / (T_2 âˆ’ T_1)} = 1.

7. If the reversed Carnot cycle operating as a refrigerator between temperature limits of 405 K and 255 K, then what is the value of C.O.P.?
a) 2.7
b) 0.588
c) 1.7
d) 0.370

Answer: c
Explanation: C.O.P. of reversed Carnot cycle is given by,
C.O.P. = T_1 / (T_2 âˆ’ T_1)
= 255 / (405 âˆ’ 255)
= 1.7.

8. A reversed Carnot cycle is operating between temperature limits of 272 K and (+) 49Â°C. If it acts as a heat engine gives an efficiency of 15.52%. What is the value of C.O.P. of a refrigerator operating under the same conditions?
a) 6.44
b) 0.1838
c) 5.44
d) 2

Answer: c
Explanation: T_1 = 272 K, T_2 = 49Â°C = 322 K
Temperature limits are given in the question so; we can calculate C.O.P. using the formula
C.O.P. = T_1 / (T_2 âˆ’ T_1)
= 272 / (322 âˆ’ 272)
= 5.44
Alternative approach:
But as the efficiency of the heat engine is given so directly by the relation, we can find out the C.O.P.
C.O.P. of heat pump = 1 / Î·$_E$
= 1 / (0.1552) = 6.44
C.O.P. of refrigerator = C.O.P. of heat pump âˆ’ 1 = 6.44 âˆ’ 1 = 5.44.

9. If the Coefficient of performance of a heat pump is 5, then what is the value of the Coefficient of performance of the refrigerator operating under the same conditions?
a) 4
b) 6
c) 0.2
d) 3

Answer: a
Explanation: As we know, the equation between Coefficient of performance of Refrigerator and heat pump:
(C.O.P.)$_R$ = (C.O.P.)$_P$ âˆ’ 1
Hence, C.O.P. of refrigerator = C.O.P. of heat pump âˆ’ 1
= 5 âˆ’ 1
= 4.

10. C.O.P. of the refrigerator is always _____ the C.O.P. of the heat pump when both are working between the same temperature limits.
a) less than
b) greater than
c) equal to
d) inverse of

Answer: a
Explanation: C.O.P. = Desired effect / Work
As the desired effect for the heat pump is higher than the refrigerator. So, numerator value is higher for heat pump keeping denominator constant.
Can also be proved by this equation,
(C.O.P.)$_R$ = (C.O.P.)$_P$ âˆ’ 1.

11. Two refrigerators M and N operate in series. The refrigerator M absorbs energy at the rate of 1 kW from a body at temperature 400 K and rejects energy as heat to a body at a temperature T. The refrigerator N absorbs the same quantity of energy which is rejected by the refrigerator N from the body at temperature T, and rejects energy as heat to a body at temperature 800 K. If both the refrigerators have the same C.O.P., what is the value temperature T?
a) 600 K

b) 200 K
c) 565.68 K
d) 459.21 K

Answer: c
Explanation: Given: T_1 = 400 K, T_2 = 800 K, C.O.P. of M = C.O.P. of N
C.O.P. of refrigerator M = T_1 / (T_2 âˆ' T_1)
= 400 / (T âˆ' 400)
C.O.P. of refrigerator N = T_1 / (T_2 âˆ' T_1)
= T / (800 âˆ' T)
Equating both the C.O.P. we get,
400 / (T âˆ' 400) = T / (800 âˆ' T)
T_2 = 400 x 800
T = âˆš320000
T = 565.68 K.

12. A refrigerator works on a reversed Carnot cycle. The Coefficient of performance is 3.5. If the capacity of the refrigerator is 6 TR. Find out the power required to run the refrigerator.
a) 5 kW
b) 3.5 kW
c) 360 kJ/min
d) 520 kJ/min

Answer: c
Explanation: Given: Q = 6 TR = 6 x 3.5 = 21 kW
C.O.P.= 3.5
C.O.P. = Desired effect / Work
Work = Q / C.O.P.
= 21 / 3.5
= 6 kw = 360 kJ/min.

13. A refrigerator works on a reversed Carnot cycle. The Coefficient of performance is 7. If the capacity of the refrigerator is 12 TR. What is the value of heat rejected from the system?
a) 46 kW
b) 50 kW
c) 42 kJ/min
d) 48 kJ/min

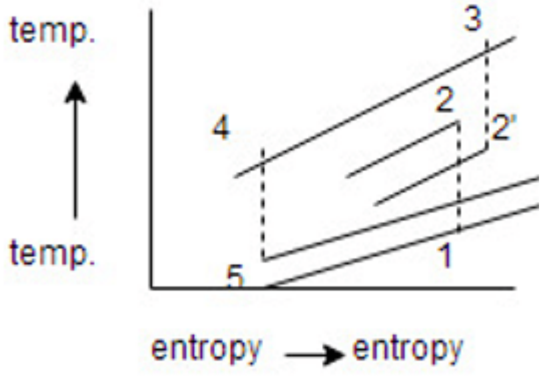
Answer: d
Explanation: Given: Q_1 = 12 TR = 12 x 3.5 = 42 kW
C.O.P. = 5
C.O.P. = Desired effect / Work
Work = Q_1 / C.O.P.
= 42/7
= 6 kW
Heat rejected from the system, Q_2 = Q_1 + W
= 42 + 6
= 48 kW.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œSimple Air Cooling Systemâ€�.

1. Which one of the following is not a component of a simple air cooling system?
a) Main compressor
b) Cooling fan
c) Heat exchanger
d) Generator

Answer: d
Explanation: The main components of simple air cooling system are the main compressor driven by the gas turbine, a cooling fan, heat exchanger and a cooling turbine.

2. For a simple air cooling system which one of the following is not a process of the cycle in T-S diagram?



a) Ramming process
b) Compression process
c) Heating process
d) Refrigeration process

Answer: c
Explanation: A simple air cooling system has 5 processes in T-S diagram namely ramming process, compression process, expansion process, refrigeration processes and cooling process.

3. The COP of simple air cooling system is given by?
T_{6} = Inside temperature of cabin
$T_{5â€²}$ = Exit temperature of cooling turbine
$T_{3â€²}$ = Temperature at the exit of compressor
$T_{2â€²}$ = Stagnation temperature
a) COP = \(\frac{(T_6 â€“ T_{5â€²})}{(T_3â€² â€“ T_{2â€²})}\)
b) COP = \(\frac{(T_6 + T_{5â€²})}{(T_3â€² â€“ T_{2â€²})}\)
c) COP = \(\frac{(T_6 + T_{5â€²})}{(T_3â€² + T_{2â€²})}\)
d) COP = \(\frac{(T_6 â€“ T_{5â€²})}{(T_3â€² + T_{2â€²})}\)

Answer: a
Explanation: COP = Refrigeration effect produced i.e. (T_6 â€“ $T_{5â€²}$) divided by Work done i.e. ($T_{3â€²}$ â€“ $T_{2â€²}$).
Hence COP = \(\frac{(T_6 â€“ T_{5â€²})}{(T_3â€² â€“ T_{2â€²})}\).

4. The simple air cooling system is good for _____ flight speed.
a) low
b) high
c) moderate
d) any

Answer: a
Explanation: The simple air cooling system is good for low flight speed so as fan can maintain airflow over the air cooler, which is difficult for it while at high speeds.

5. What is the main difference between simple air cooling system and simple air evaporative cooling system?
a) Simple air evaporative cooling system has an evaporator
b) Simple air evaporative cooling system has two evaporators
c) Simple air evaporative cooling system has an extra compressor
d) Simple air evaporative cooling system has three evaporators

Answer: a
Explanation: The difference between the simple air cooling system and simple air evaporative cooling system is that it has an evaporator between the heat exchanger and the cooling turbine.

6. If cooling of 45 minutes or less is required, it may be advantageous to use evaporative cooling system.
a) True
b) False

Answer: a
Explanation: The evaporative cooling system provides an additional cooling effect through evaporation of refrigerants such as water etc. Hence if cooling of 45 minutes or less is required, it may be advantageous to use evaporative cooling system.

7. A simple evaporative air refrigeration system is used for an airplane to take 20 TR of refrigeration load (Q). The power required for the refrigerating system P is 746 KW. What is its COP?
a) 0.086
b) 0.094
c) 0.079
d) 0.099

Answer: b
Explanation: COP = \(\frac{(210Ã—Q)}{(PÃ—60)}\)
COP = \(\frac{(210Ã—20)}{(746Ã—60)}\)
= 0.094.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œRegenerative Air Cooling Systemâ€�.

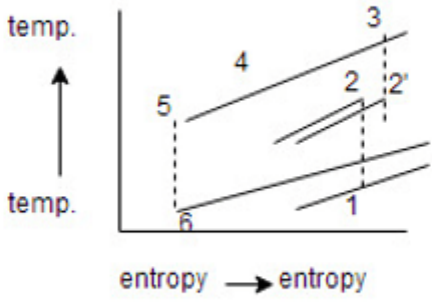
1. Regeneration cooling system is a modification of _________
a) simple air cooling system
b) simple evaporative cooling system
c) boot-strap cooling system
d) boot-strap evaporative cooling system

Answer: a
Explanation: Regenerative air cooling system is a modification of simple air cooling system by the addition of a regenerative heat exchanger.

2. Cooling system used for supersonic aircrafts and rockets is?
a) Simple air cooling system
b) Simple evaporative cooling system
c) Boot-strap cooling system
d) Regeneration cooling system

Answer: c
Explanation: Cooling system used for supersonic aircrafts and rockets is of regeneration cooling system type, due to the regenerative heat exchanger and they give lower turbine discharge temperatures than simple air cooling system.

3. Which of the following is not a process in the T-s diagram of the regeneration cooling system?



a) Isentropic ramming
b) Isentropic compression
c) Cooling of air by ram air in the heat exchanger and then cooling of air in regenerative heat exchanger
d) Isothermal expansion

Answer: d
Explanation: T-s diagram of regenerative air cooling system consists of Isentropic ramming, Isentropic compression, Cooling of air by ram air in the heat exchanger and then cooling of air in regenerative heat exchanger, Isentropic compression, isentropic expansion and then heating of air.

4. Simple air cooling system gives maximum cooling effect on ground surface whereas regeneration cooling system has more effect during high speeds.
a) True
b) False

Answer: a
Explanation: Simple air cooling system gives maximum cooling effect on ground surface whereas regeneration cooling system has more effect during high speeds because it gives low turbine discharge temperature than the simple air cooling system.

5. Calculate the power required (P) for maintaining the cabin temperature, when the COP of the regenerative cooling system is given to be 0.25 and the refrigeration load (Q) is 25.
a) 305
b) 350
c) 530

d) 503

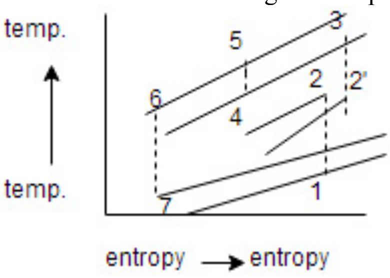
Answer: b
Explanation: COP = \(\frac{210Ã—Q}{PÃ—60}\)
0.25 = \(\frac{210Ã—25}{PÃ—60}\)
P = 350 KW.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œBoot â€“ Strap Air Cooling Systemâ€�.

1. In Boot-strap air cooling system how many heat exchangers are there?
a) 1
b) 2
c) 3
d) 0

Answer: b
Explanation: In Boot-strap air cooling system there are two heat exchangers and a cooling turbine driving the secondary compressor instead of the cooling fan.

2. Which of the following is not a process in the T-s diagram of the Boot-strap air cooling system?



a) Isentropic ramming
b) Isentropic compression
c) Cooling of ram air
d) Isothermal expansion

Answer: d
Explanation: T-s diagram of Boot-strap air cooling system consists of Isentropic ramming, Isentropic compression, Cooling of ram air in first heat exchanger, Isentropic compression, cooling of ram air in the second heat exchanger, isentropic expansion and then heating of air.

3. What is the difference between Boot-strap air cooling system and Boot-strap evaporative cooling system?
a) Boot strap evaporative system has an evaporator
b) Boot strap evaporative system has two evaporators
c) Boot-strap evaporator eliminates the need for evaporator
d) Boot-strap evaporator system has three evaporators

Answer: a
Explanation: Boot strap evaporative system has an evaporator between the second heat exchanger and the cooling turbine.

4. Mass of air per tonne of refrigeration will be _____ in Boot-strap air cooling system than Boot-strap evaporative system.
a) less
b) more
c) equal to
d) canâ€™t say

Answer: b
Explanation: Since the temperature of air leaving the cooling turbine in boot-strap system is lower than the simple boot-strap system, therefore the mass of air per tonne of refrigeration will be more in boot-strap air cooling system.

5. The air cooling system that is used mostly in transport type aircraft is?
a) Boot-strap air cooling system
b) Simple air cooling system
c) Simple evaporative cooling system
d) Regenerative air cooling system

Answer: a
Explanation: Boot-strap air cooling system uses a secondary air compressor along with an after cooler for achieving higher pressures of compression and more cooling effect. The cooling turbine replaces the use of cooling fan as well. Hence the air cooling system that is used mostly in transport type aircraft is Boot-strap air cooling system.

6. A Boot-strap air cooling system is used for a transport aircraft to take 10TR of refrigeration load (Q). The power required for the refrigerating system P is 800 KW. What is its COP?
a) 0.06426
b) 0.04375
c) 0.05435
d) 0.04367

Answer: b
Explanation: COP = \(\frac{210Ã—Q}{PÃ—60}\)
COP = \(\frac{210Ã—10}{800Ã—60}\)
= 0.04375.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œMechanism of Simple VCR Systemâ€�.

1. A vapor compression refrigeration system is an improved type of air refrigeration system in which a suitable working substance, termed as refrigerant is used.
a) True
b) False

Answer: a
Explanation: A vapor compression refrigeration system is an improved type of air refrigeration system in which a suitable working substance, termed as refrigerant is used. Refrigerants such as ammonia, CO_2 and Sulphur dioxide etc. are used as refrigerants in a vapor compression refrigeration system.

2. The vapor compression refrigeration system is similar to a ________
a) latent heat pump
b) latent heat engine
c) generator
d) evaporator

Answer: a
Explanation: The vapor compression refrigeration system is a latent heat pump, as it pumps its latent heat from the brine and delivers it to the cooler.

3. The first vapor compression refrigeration system was developed by ________
a) L. G. Hamilton
b) Jacob Perkins
c) Stephen Rossi
d) Lenard Sandwik

Answer: b
Explanation: The first vapor compression refrigeration system was developed in 1834 by Jacob Perkins using hand operations.

4. The COP of vapor compression refrigeration compared to simple air refrigeration system is ________
a) high
b) low
c) same
d) canâ€™t say

Answer: a
Explanation: COP of vapor compression refrigeration compared to simple air refrigeration system is high due to the use of refrigerant and as it can be employed over large range of temperatures.

5. Which of the following is not an advantage of vapor compression refrigeration system over air refrigeration system?
a) Smaller size for a given capacity of refrigeration
b) It has less running cost
c) It can be employed over wide range of temperature
d) There is no problem of leakage in vapor compression refrigeration system

Answer: d
Explanation: In vapor compression refrigeration system the prevention of leakage of the refrigerant is a major problem. The advantages of it are smaller size for a given capacity of refrigeration, it has less running cost and it can be employed over wide range of temperature.

6. The low pressure and temperature vapor refrigerant enters the ______ of the vapor compression system.
a) compressor
b) condenser
c) receiver
d) evaporator

Answer: a
Explanation: In the compressor the low pressure and temperature vapor refrigerant from the evaporator is drawn through the suction valve, where it is compressed to high pressure and temperature.

7. The high pressure and temperature vapor refrigerant enters the ______ of the vapor compression system.
a) compressor
b) condenser
c) receiver
d) evaporator

Answer: b
Explanation: In the condenser the high pressure and temperature vapor refrigerant from the compressor is condensed, during which the refrigerant gives up its latent heat.

8. In any compression refrigeration system there are how many pressure conditions?
a) 1
b) 2
c) 3
d) 4

Answer: b
Explanation: In any compression refrigeration system there are 2 pressure conditions, namely high pressure and low pressure side.

9. Which of the following is not an advantage of vapor compression cycle over reversed Carnot cycle?
a) Itâ€™ COP and refrigeration effect canâ€™t be increased

b) Use of expansion valve reduces the size and cost of plant
c) It is a practical cycle on which plant can be built
d) Wet compression of Carnot cycle is avoided

Answer: a
Explanation: Itâ€™ COP and refrigeration effect can be increased by use of superheated vapor at entry of compressor. The advantages are use of expansion valve reduces the size and cost of plant, it is a practical cycle on which plant can be built and wet compression of Carnot cycle is avoided.

10. The pipe line emanating from compressor up to the condenser is called ________
a) suction line
b) pipe line
c) liquid line
d) delivery line

Answer: d
Explanation: The pipe line emanating from compressor up to the condenser is called delivery line or discharge line or hot gas line. Whereas suction line is the low pressure vapor line from the exit end evaporator leading to the compressor suction side and liquid line carries the liquid from receiver to the control valve.

11. The coefficient of performance of a vapour compression refrigeration system is quite high as compared to the air refrigeration system.
a) True
b) False

Answer: a
Explanation: VCRS uses a refrigerant having specific properties. The most important properties include heat absorbing and rejecting capacities. Due to the occurrence of phase change of refrigerant in the Vapor compression refrigeration system and high-temperature range applicability, it has higher COP. VCRS used in applications like refrigerators for domestic and industrial applications.

12. In a refrigeration cycle, in which of the following heat absorption takes place?
a) Evaporator
b) Condenser
c) Expansion valve
d) Compressor

Answer: a
Explanation: Evaporator helps to raise the temperature of the refrigerant and convert that liquid form into gaseous form. For that, it absorbs heat energy from the items placed in the system. Utilizing that heat to make the phase change.

13. After which process during the VCR cycle, the highest temperature is achieved?
a) Evaporation
b) Expansion
c) Condensation
d) Compression

Answer: d
Explanation: The compression process is used to increase the pressure. So, according to Gay-Lussacâ€™s law,
P â^� T
As the highest pressure obtained after compression, the temperature obtained is also the highest.

14. The expansion valve in a refrigerator does not control the flow of refrigerant.
a) False
b) True

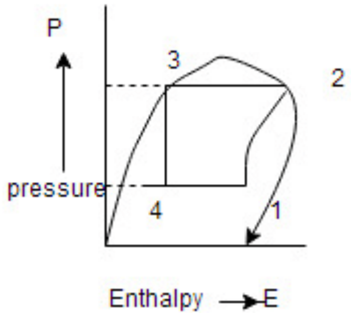
Answer: a
Explanation: Expansion valve acts as a diffuser, where pressure reduction is carried out using an orifice. By controlling the flow of refrigerant flowing through an orifice, the desired pressure drops obtained.

15. In a domestic vapour compression refrigerator, which of the following refrigerants commonly used?
a) CO_2
b) NH_3
c) Freon
d) Air

Answer: c
Explanation: FREON is a trading name for several gases called refrigerants. Commonly used refrigerants are hydrofluorocarbons and hydrocarbons. Though ammonia and dichlorodifluoromethane have the same boiling point, it is not toxic like ammonia. Hence, it is safe to use Freon than ammonia.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œTheoretical VCR with Dry Saturated Vapour after Compression â€“ 1â€�.

1. In vapor compression cycle having dry saturated vapor at the end of compression the work done is given by?

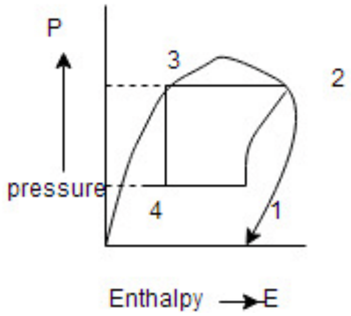


H_2 â€“ Enthalpy of vapor after compression
H_1 â€“ Enthalpy of vapor before compression
a) H_2 â€“ H_1
b) $H_2 + H_1$
c) H_2 Ã— H_1

d) H_2 Ã· H_1

Answer: a
Explanation: Work is done on the compressor in the compression process (1 â€“ 2), and the external work-done in the remainder process of the cycle is zero. Hence the net work-done equals to the compressor work.

2. In vapor compression cycle having dry saturated vapor at the end of compression the refrigeration effect is given by?



H_1 â€“ Enthalpy of vapor before compression
H_4 â€“ Enthalpy of vapor before entering evaporator
H_2 â€“ Enthalpy of vapor after compression
a) H_1 â€“ H_4
b) H_2 â€“ H_4
c) H_1 Ã— H_4

d) H_2 Ã— H_4

Answer: a
Explanation: Refrigeration effect is the heat absorbed by the vaporizing refrigerant in the evaporator during the process (4 â€“ 1), therefore refrigeration effect = H_1 â€“ H_4 .

3. The COP of vapor compression having vapor as dry saturated after compression having refrigeration effect (Re) of 58.84 and work done (W) of 17.95 is ________
a) 3.278
b) 4.39
c) 4.234
d) 3.865

Answer: a
Explanation: The COP is given by Refrigeration effect by work done,
COP=\(\frac{Re}{W}\)
=\(\frac{58.84}{17.95}\)=3.278.

4. Entropy of dry-saturated vapor when S_f is 0.2513 and S_{fg} is 4.7878, is _______
S_f â€“ Entropy of saturated liquid at pressure p
S_{fg} â€“ Entropy change during vaporization
a) 6.987
b) 5.987
c) 5.0391
d) 4.776

Answer: c
Explanation: Entropy of dry-saturated vapor when S_f is 0.2513 and S_{fg} is 4.5819, is given by
$S_g = S_f + S_{fg} = 0.2513+4.7878 = 5.0391$.

5. One of the assumptions of the vapor compression cycle is that all of the processes are reversible.
a) True
b) False

Answer: a
Explanation: Vapor compression cycle with vapor being dry saturated after compression is a theoretical cycle having various assumptions. One of the assumptions is that all the processes are reversible.

6. In which case does the compression process remains in superheated state?
a) Wet state
b) Dry state
c) Semi-dry state
d) Always

Answer: b
Explanation: In case of dry state the compression process remains in superheated state i.e. for compression of dry-saturated vapor or superheated vapor.

7. Dry compression is preferred over wet compression.
a) True
b) False

Answer: a
Explanation: Dry compression is preferred over wet compression since it gives high volumetric efficiency and mechanical efficiency of the compressor with less chances of damage to it. However, in some cases wet compression is preferred when the compression is done using a screw or rotary compressor.

8. The ratio of COP of vapor compression cycle and COP of Carnot cycle is known as?
a) Relative COP
b) Ideal COP
c) Performance index
d) Theoretical COP

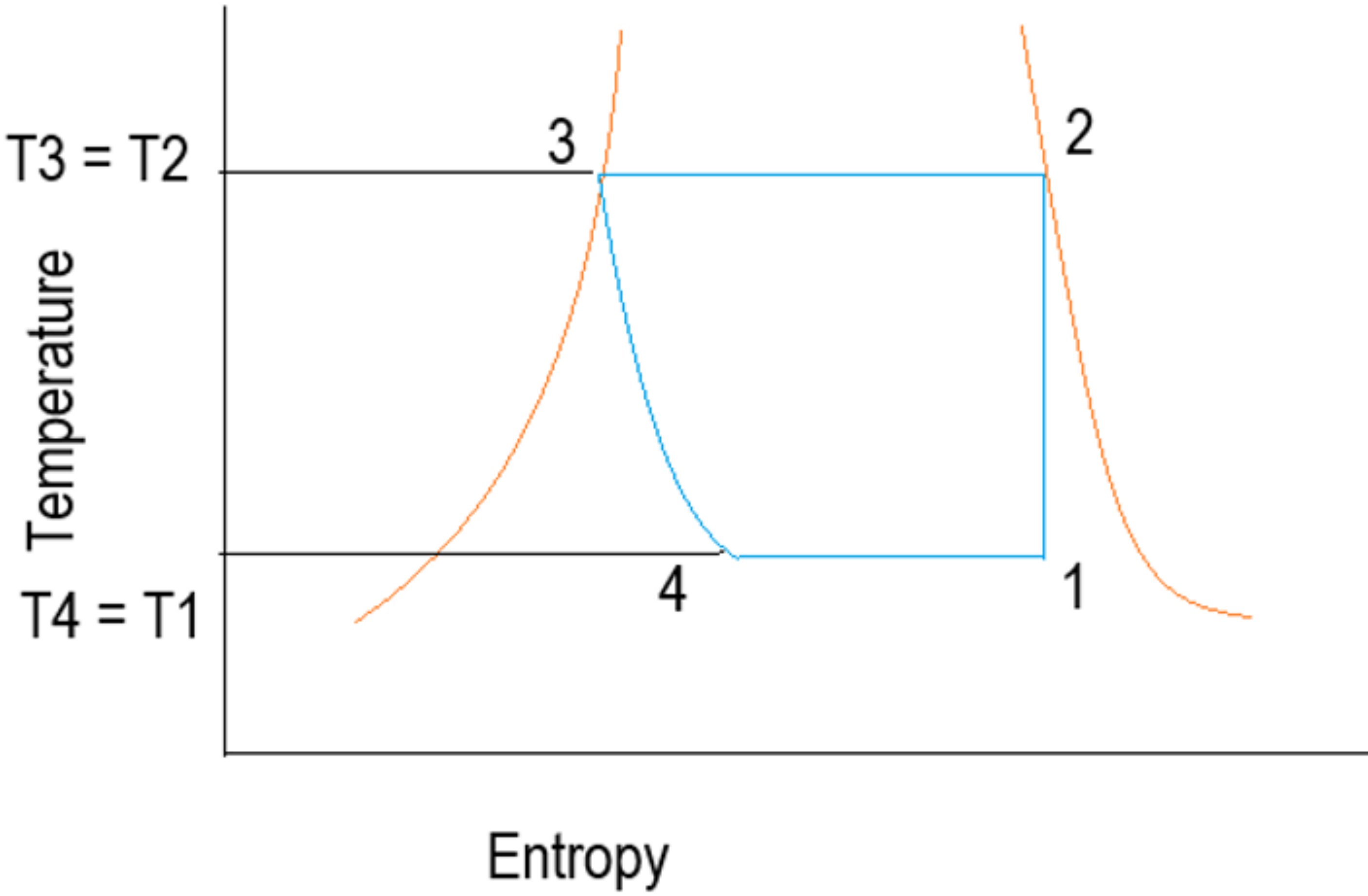
Answer: c
Explanation: The ratio of COP of vapor compression cycle and COP of Carnot cycle is known as the Refrigeration efficiency or performance index (P.I). Whereas relative COP is the ratio of Actual COP divided by Ideal COP.

This set of Refrigeration Quiz focuses on â€œTheoretical VCR with Dry Saturated Vapour after Compression â€“ 2â€�.

1. Refrigerating effect corresponds to which of the following processes?
a) Condensing process
b) Vaporizing process
c) Compression process
d) Expansion process

Answer: b
Explanation: During evaporation, the refrigerant absorbs its latent heat of vaporization from the medium or system which is to be cooled. So, the heat absorbed by the refrigerant is known as Refrigerating effect carried out in the vaporizing process.

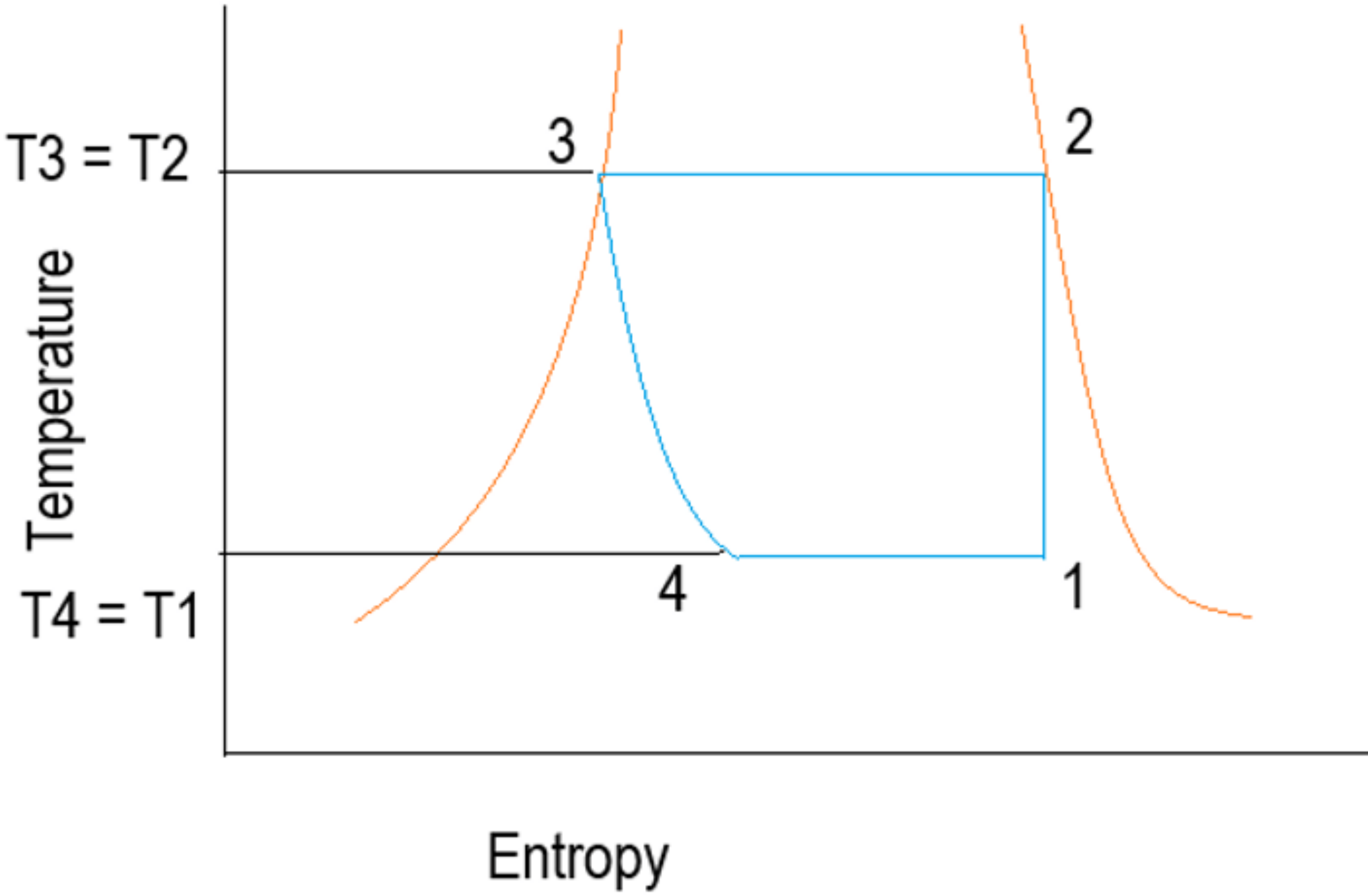
2. What does the process 1-2 represent?



a) Condensation
b) Evaporation
c) Compression
d) Expansion

Answer: c
Explanation: As from 1-2 temperature is increasing by keeping change in entropy constant. By Gay-Lussacâ€™s law, the pressure is proportional to temperature. Hence, pressure also increasing from point 1-2. It represents the compression process where pressure is increased.

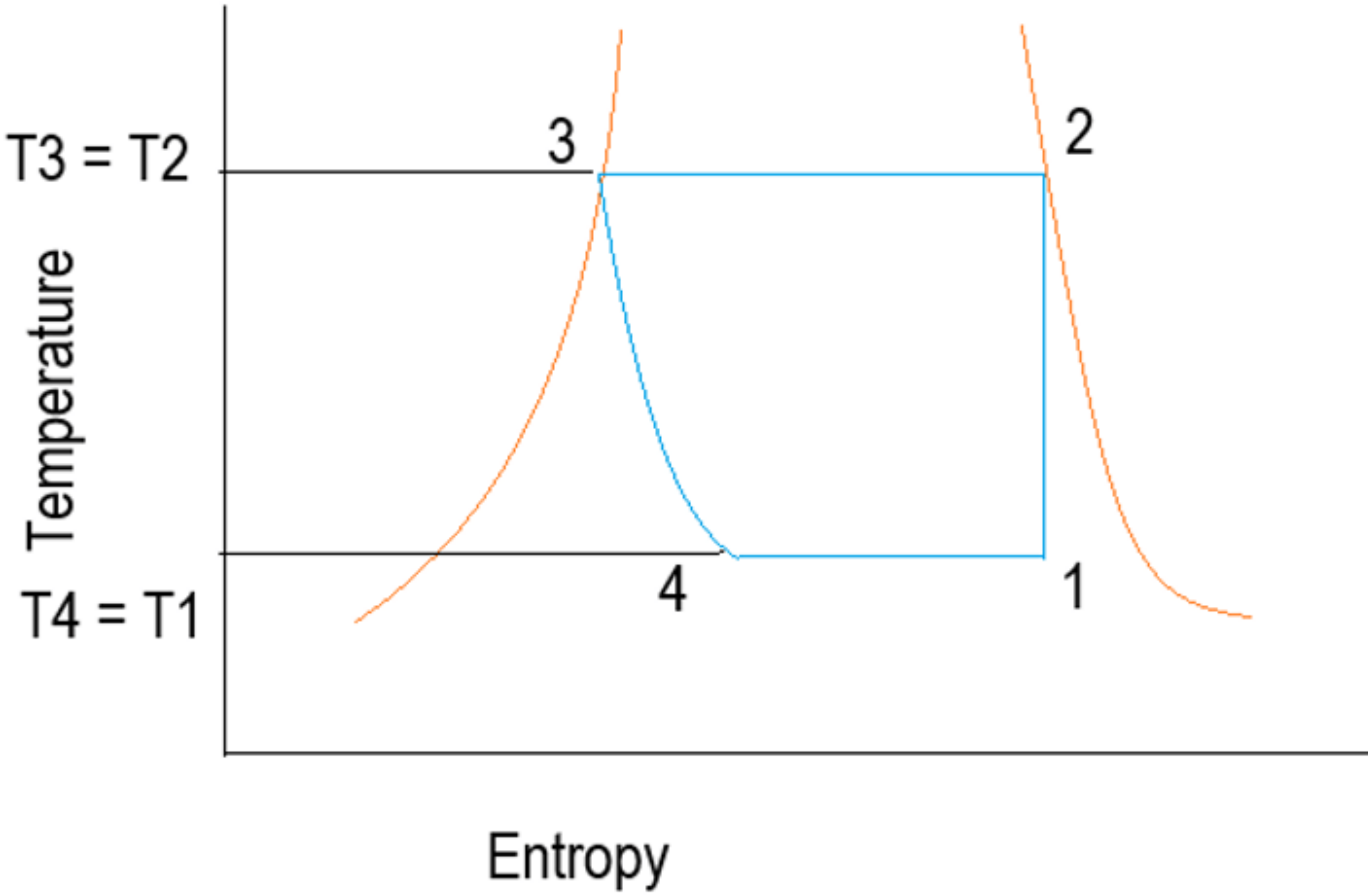
3. What does the process 2-3 represent?



a) Condensation
b) Evaporation
c) Compression
d) Expansion

Answer: a
Explanation: As in the process 2-3, the temperature is constant by decreasing the change in entropy. As entropy change is related to heat transfer the second law of thermodynamics. Change in entropy is reduced. Hence, heat is rejected. So, it is a condensation process.

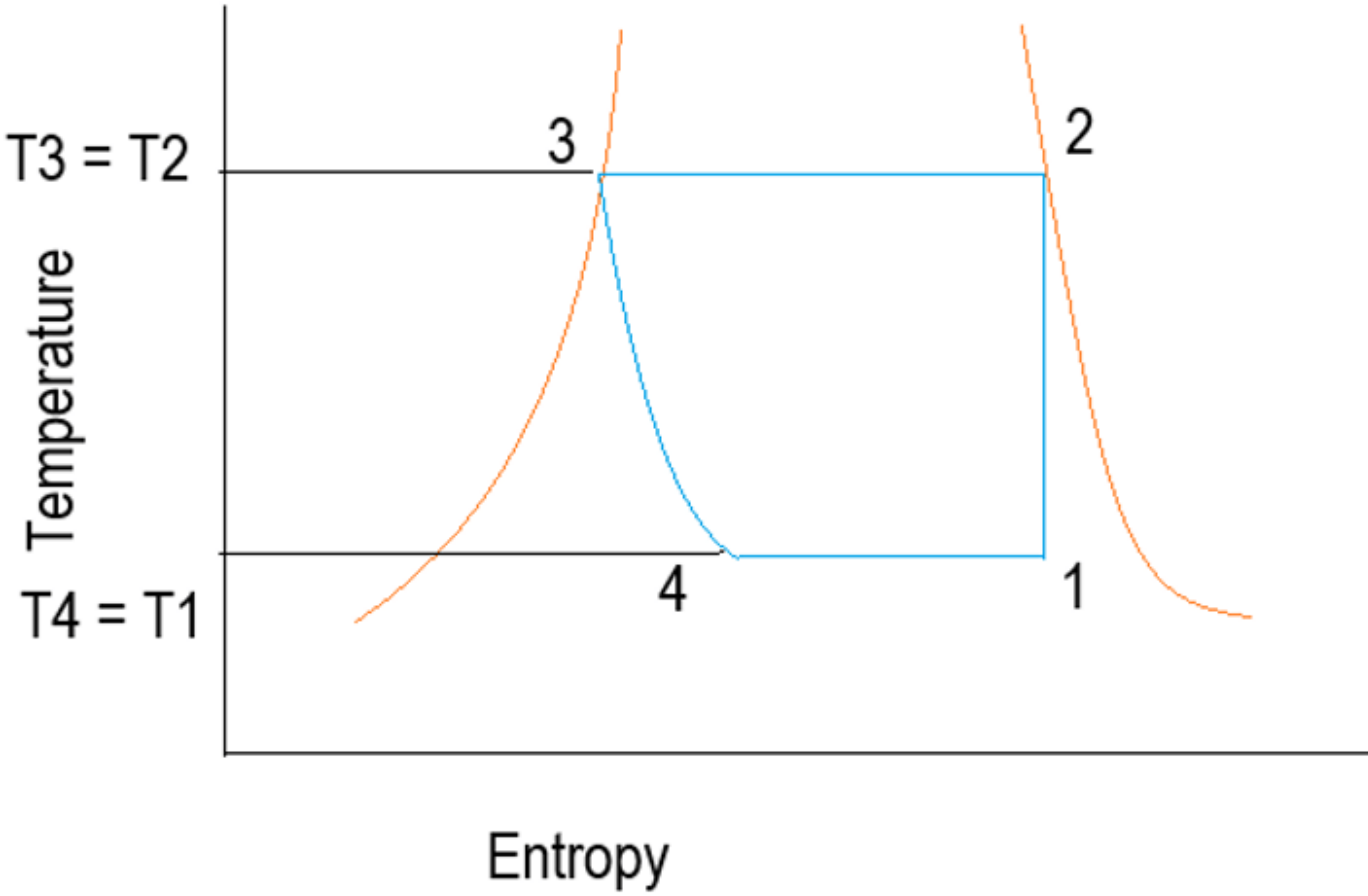
4. What does the process 3-4 represent?



a) Condensation
b) Evaporation
c) Compression
d) Expansion

Answer: d
Explanation: As in the process 3-4, the temperature is decreased and also decrease in an optimal change in entropy. As pressure is reduced as well as optimal heat transfer is carried out to get the desired phase. These both processes are observed in Expansion, not only decreasing pressure is essential but also stabilizing the randomness of particles.

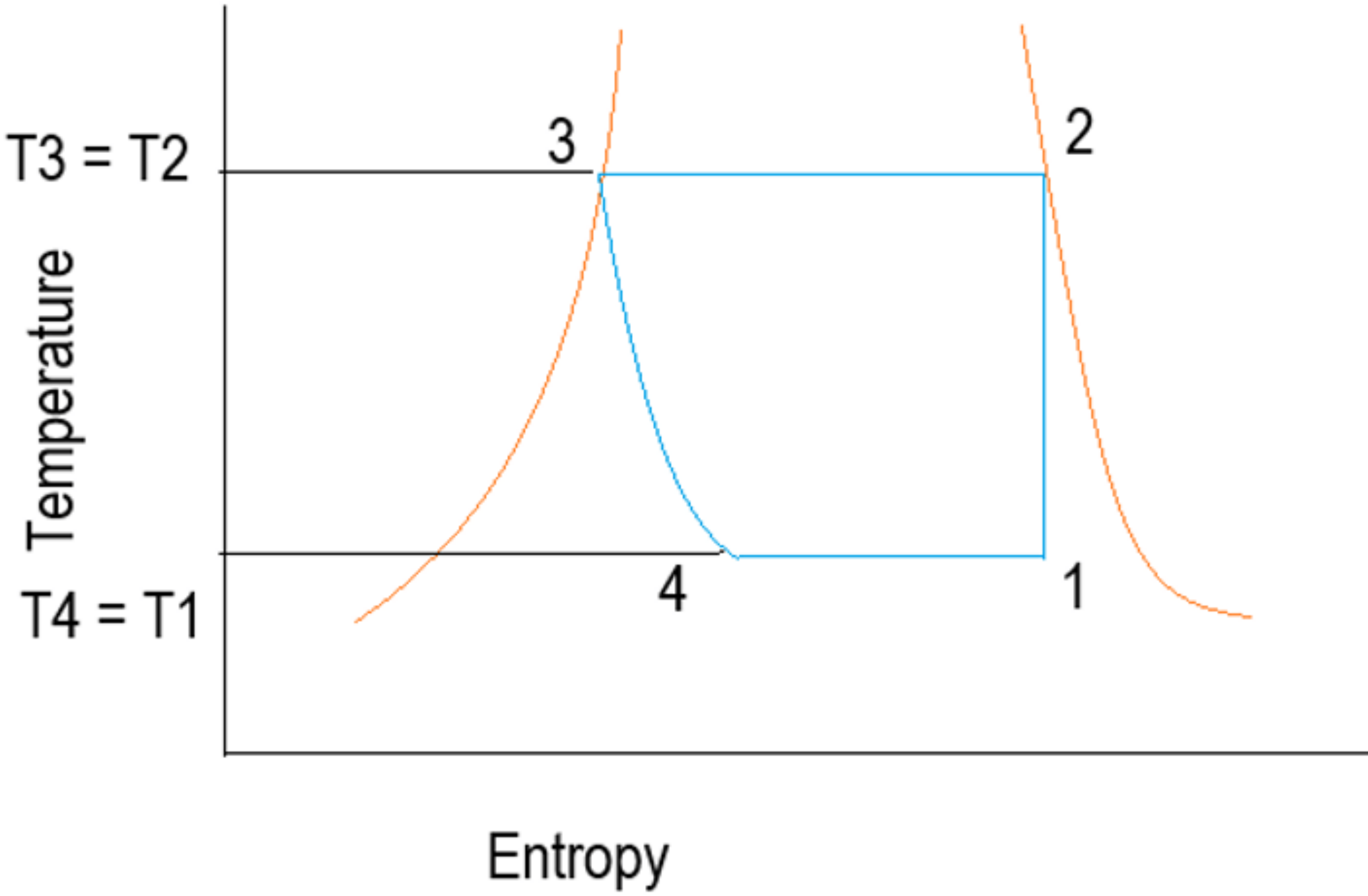
5. What does the process 2-3 represent?



a) Condensation
b) Evaporation
c) Compression
d) Expansion

Answer: b
Explanation: As in the process 4-1, the temperature is constant by increasing the change in entropy. As entropy change is related to heat transfer the second law of thermodynamics. Change in entropy is increased by increasing the randomness done by phase change. Hence, heat is absorbed. So, it is an evaporation process.

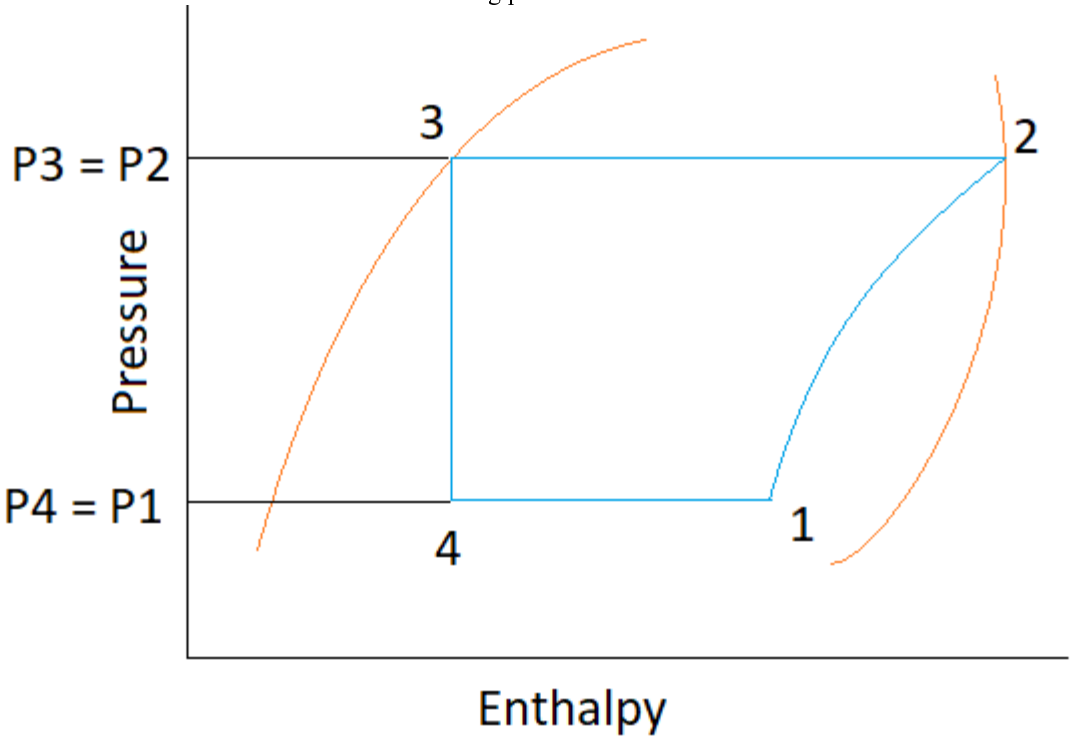
6. What does point 2 say about the state of refrigerant?



a) Wet vapor
b) Dry saturated vapor
c) Superheated vapor
d) Liquid refrigerant

Answer: b
Explanation: Point 2 lies on the saturated vapor line. Hence, it is a dry saturated vapor containing no liquid particles. If the point is inside the curve, then it is wet vapor. If it is outside the line, it is superheated vapor. It cannot be liquid after compression.

7. What is the value of C.O.P. for the following p-h chart?



a) (h $_1$ âˆ’ h $_4$) / (h $_2$ âˆ’ h $_1$)
b) (h $_3$ âˆ’ h $_4$) / (h $_2$ âˆ’ h $_1$)
c) (h $_2$ âˆ’ h $_4$) / (h $_2$ âˆ’ h $_3$)
d) (h $_1$ âˆ’ h $_2$) / (h $_3$ âˆ’ h $_4$)

Answer: a
Explanation: C.O.P. = Refrigerating effect / Work done
As, Refrigerating effect = Process 1-4 = h_1 âˆ’ h_4
Work done = Process 1-2 = h_2 âˆ’ h_1
Hence, C.O.P. = (h_1 âˆ’ h_4) / (h_2 âˆ’ h_1).

8. Find out the value of C.O.P. for the given values of enthalpies.
h_1 = 1126.25 kJ/kg
h_4 = 250.25 kJ/kg
W = 120 kJ/kg
a) 5.3
b) 6.3
c) 7.3
d) 8.3

Answer: c
Explanation: Refrigerating effect = h_1 âˆ’ h_4 = 1126.25 âˆ’ 250.25 = 876 kJ/kg
Work = 120 kJ/kg
C.O.P. = Refrigerating effect / Work done
= 876 / 120
= 7.3.

9. If a process 1 â€“ 2 undergoes a throttling. Which of the following represents the process 1 â€“ 2?
a) T1 = T2
b) S1 = S2
c) P1 = P2
d) H1 = H2

Answer: d
Explanation: In a throttling process, no heat is absorbed or rejected by the liquid refrigerant. It is also called as an isenthalpic process, in which change in internal energy and flow work remains the same. Enthalpies remain same, so H1 = H2 represents throttling.
T1 = T2 is the isothermal process.
S1 = S2 is an isentropic process.
P1 = P2 is an isobaric process.

10. In a vapor compression refrigeration system, the coefficient of performance is observed as 10. If the enthalpy after compression is 1368.28 kJ/kg and after condensation is 598.58 kJ/kg. If the system works on 50% of the C.O.P., then what is the value of enthalpy after evaporation?
a) 1220
b) 1210
c) 1240
d) 1280

Answer: c
Explanation: Given data: Theoretical C.O.P. = 10
h_2 = 1368.28 kJ/kg
h_4 = h_3 = 598.58 kJ/kg
Calculations: Actual C.O.P. = 50 * 10 / 100 = 5
As, C.O.P. = (h_1 âˆ’ h_4) / (h_2 âˆ’ h_1)
5 = (h_1 âˆ’ 598.58) / (1368.28 âˆ’ h_1)
h_1 = 1239.99 = 1240 kJ/kg.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œTheoretical VCR with Wet Vapour after Compressionâ€�.

1. The COP of vapor compression when vapor is wet after compression having refrigeration effect (Re) of 60 and work done (W) of 20 is?
a) 3
b) 4
c) 4.2
d) 5

Answer: a
Explanation: The COP is given by Refrigeration effect by work done,
COP=$\frac{Re}{W}$
= $\frac{60}{20}$ = 3.0.

2. Which case is when the refrigerant compression process is carried while itâ€™s wet?
a) Wet state
b) Dry state
c) Semi-dry state
d) Always

Answer: a
Explanation: In case of wet state the vapor compression process remains in wet state i.e. for compression of refrigerant is carried out while itâ€™s still wet and for dry state compression is done in dry state.

3. In case of reciprocating compressors, wet compression is avoided.
a) True
b) False

Answer: a
Explanation: In case of reciprocating compressors, wet compression is avoided as the liquid droplets in the refrigerant would enter the compressor and damage the valves and other moving parts.

4. Which one of the following is not an assumption in theoretical vapour compression cycle?
a) There are no pressure losses in the condenser, evaporator, compressor, valves and the connecting part lines
b) All processes are reversible
c) There are mechanical and fluid friction losses
d) There is no heat transfer between the system and surroundings except in the evaporator and condenser

Answer: c
Explanation: There are no mechanical or fluid friction losses, is one of the assumptions made in theoretical vapor compression cycle. The other assumptions are all processes are reversible, there is no heat transfer between the system and surroundings except in the evaporator and condenser and there are no pressure losses in the condenser, evaporator, compressor, valves and the connecting part lines.

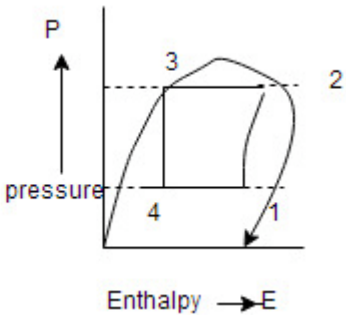
5. Power consumption in dry compression is less than wet compression.
a) True
b) False

Answer: b
Explanation: It is found that the power consumption is about 8%-10% less with wet compression compared to dry-compression. Hence power consumption in dry compression is less than wet compression.

6. Due to what in wet-compression affects the heat transfer rates from the vapor refrigerant to the cooling medium?
a) Liquid droplets
b) Work consumed
c) Power required
d) In wet-compression the heat transfer remains unaffected

Answer: a
Explanation: In wet â€“ compression the liquid droplets may carry the lubricating oil from the cylinder walls of the compressor. This oil would then pass into the condenser and adversely affect the heat transfer rates from the vapor refrigerant to the cooling medium.

7. The following p â€“ h diagram indicates?



a) Vapor compression when vapor is dry at the end of the compression
b) Vapor compression when vapor is wet at the end of the compression
c) Vapor compression when vapor is dry â€“ saturated at the end of the compression
d) Vapor compression when vapor is dry before of compression

Answer: b
Explanation: As from the diagram we can see that the compression line does not touch the saturated line it means that the vapor after compression is wet. For dry compression, it shouldâ€™ve touched the saturation line.

This set of Advanced Refrigeration Questions and Answers focuses on â€œTheoretical VCR with Superheated Vapour before and after Compressionâ€�.

1. The net effect of superheating is to have ________ COP.
a) higher
b) lower
c) moderate
d) higher or lower depending on the refrigerant used

Answer: b
Explanation: Superheating increases the refrigeration effect as well the work done in compressor, as the increase in refrigeration effect is less than the increase in work done for some refrigerants and more in other refrigerants, the net effect of superheating is to increase or decrease the COP.

2. The COP of vapor compression when vapor is superheated after compression having refrigeration effect (Re) of 360 and work done (W) of 40 is?
a) 8
b) 6.7
c) 7.8

d) 9

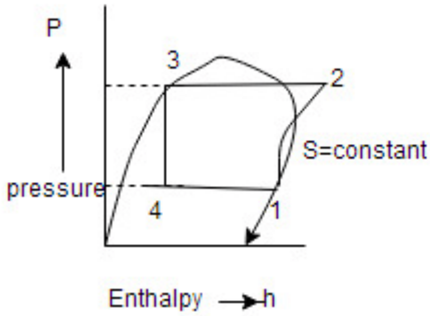
Answer: d
Explanation: The COP is given by Refrigeration effect by work done,
COP=\(\frac{Re}{W}=\frac{360}{40}\)=9.

3. What is the mass flow rate of the refrigerant when the heat required is 100 MJ/hr, enthalpy at discharge H_2 is 434.5 KJ/kg and enthalpy of liquid Hf_3 in KJ/kg at point 3 in p-h diagram is 271.97?

a) 10.254 kg/hr
b) 15.56 kg/hr
c) 10.254 kg/min
d) 15.56 kg/min

Answer: c
Explanation: mass flow rate = \(\frac{Q}{H_2 â€“ Hf_3}
= \frac{100Ã—1000}{434.5 â€“ 271.97} \)
= 10.254 kg/min.

4. The cycle in which the evaporation starts at point 4 and continues up to point 1 where it is dry-saturated is called?

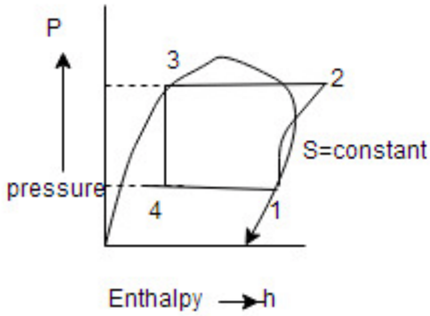


a) Theoretical VCR with dry vapor compression
b) Theoretical VCR with wet vapor compression
c) Theoretical VCR with super â€“ heated vapor after compression

d) Theoretical VCR with super â€“ heated vapor before compression

Answer: d
Explanation: In theoretical VCR with super â€“ heated vapor before compression, the vapor is superheated before entering the compressor up to point 1.

5. What is the COP of performance of the plant when the vapor is superheated 5 degree C before entering the compressor and
H_1 â€“ Enthalpy before compression = 180
H_2 â€“ Enthalpy after compression = 215
Hf_3 â€“ Enthalpy at the end of condensation = 55
H_4 â€“ Enthalpy at the end of expansion = 55



a) 5.7
b) 4.8
c) 4.7
d) 3.5

Answer: d
Explanation: The COP of performance of the plant when the vapor is superheated 5 degree C before entering the compressor = \(\frac{H_1 â€“ Hf_3}{H_2 â€“ H_1}=\frac{180 â€“ 55}{215 â€“ 180}\) = 3.57.

6. In domestic vapor compression refrigeration, the refrigerant commonly used is?
a) Freon â€“ 12

b) CO_2
c) H_2O
d) Ammonia

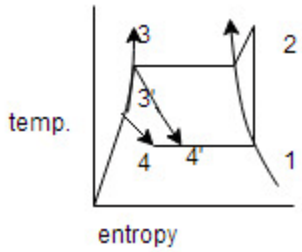
Answer: a
Explanation: In domestic vapor compression refrigeration, the refrigerant commonly used is Freon â€“ 12 because of its safe properties, stability, miscibility with oil and suitable to wide range of operating temperatures.

7. Superheating before compression increases the refrigeration effect.
a) True
b) False

Answer: a
Explanation: Superheating before compression increases the refrigeration effect and the work done as well, as the superheating increases the enthalpy of the vapor entering the compressor and thus increases the refrigerating effect.

This set of Refrigeration Problems focuses on â€œTheoretical VCR with Under Cooling or Sub-Coolingâ€�.

1. What type of VCR is shown in the T â€“ s diagram?



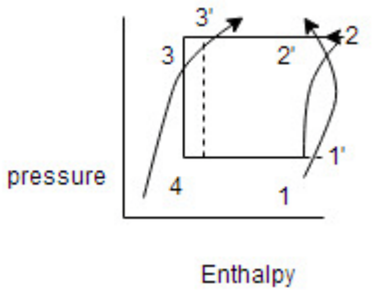
a) Theoretical VCR with sub-cooling or under cooling
b) Theoretical VCR with wet before compression

c) Theoretical VCR with wet after compression
d) Theoretical VCR with dry compression
Answer: a
Explanation: In the shown T â€“ s diagram the refrigerant after condensation process is cooled below the saturation temperature before expansion by throttling. This type of process is called undercooling or subcooling of the refrigerant.

2. The ultimate effect of undercooling is to increase the value of COP under same set of conditions.
a) True
b) False

Answer: a
Explanation: It is true that the ultimate effect of undercooling is to increase the value of COP under same set of conditions as the refrigeration effect is increased using superheating and undercooling processes.

3. What is the COP of a theoretical VCR having an undercooling of 5Â° C. Use the following data.

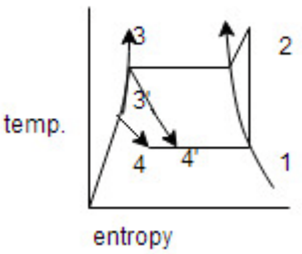


Enthalpy H_1 = 180.5,
Enthalpy H_2 = 194.5,
Enthalpy $H_{f3â€²}$ = 45.5,
Specific heat at constant pressure for superheated liquid = 0.95KJ/kg K.
a) 12.332

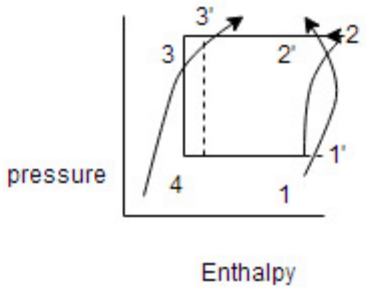
b) 9.982
c) 8.973
d) 9.879
Answer: b
Explanation: We know that enthalpy of liquid refrigerant at point 3,
H_{f3} = $H_{\text{f3â€²}}$ â€“ cpl Ã— degree of undercooling
H_{f3} = 45.5 â€“ 0.95 Ã— 5
= 40.75
COP = \(\frac{H_1 â€“ H_{f3}}{H_2 â€“ H_1} = \frac{180.5 â€“ 40.75}{194.5- 180.5}\) = 9.982.

4. The process of under cooling the refrigerant below the saturation temperature happens after?
a) Compression
b) Before condensation
c) Evaporation
d) Before throttling

Answer: d
Explanation: We can see from the below diagrams, of theoretical VCR with under cooling that the under cooling process takes place before throttling.
T â€“ s diagram



P â€“ h diagram



5. The process of under cooling can only be brought about by circulating more quantity of cooling water through the condenser or by using water colder than the main circulating water.
a) True
b) False

Answer: b
Explanation: There are various processes by which under cooling can be brought about some of them are by circulating more quantity of cooling water through the condenser, by using water colder than the main circulating water and employing a heat exchanger.

6. What effect does the under cooling process have on piston displacement of the compressor?
a) Increases
b) Reduces
c) No effect
d) Canâ€™t say from the given data

Answer: b
Explanation: Though the compressor work remains same per kg of refrigerant, but, it reduces the compressor power per ton of refrigeration due to reduced mass flow rate of refrigerant. Also it reduces the piston displacement of the compressor.

7. The effect of liquid sub cooling is less pronounced in case of?
a) Water
b) CO_2
c) NH_3
d) Effect is same for all the liquids

Answer: c
Explanation: The effect of liquid sub cooling is less pronounced in case of NH_3 as refrigerant, since it has large latent heat of vaporization as compared to its liquid specific heat.

8. The difference between the saturation temperature T_3 of liquid refrigerant at pressure $p_3 = p_2$ and the actual temperature of liquid refrigerant $T_{3â€²}$ is called?
a) Degree of freedom
b) Degree of subcooling
c) Degree of superheating
d) Degree of condensation

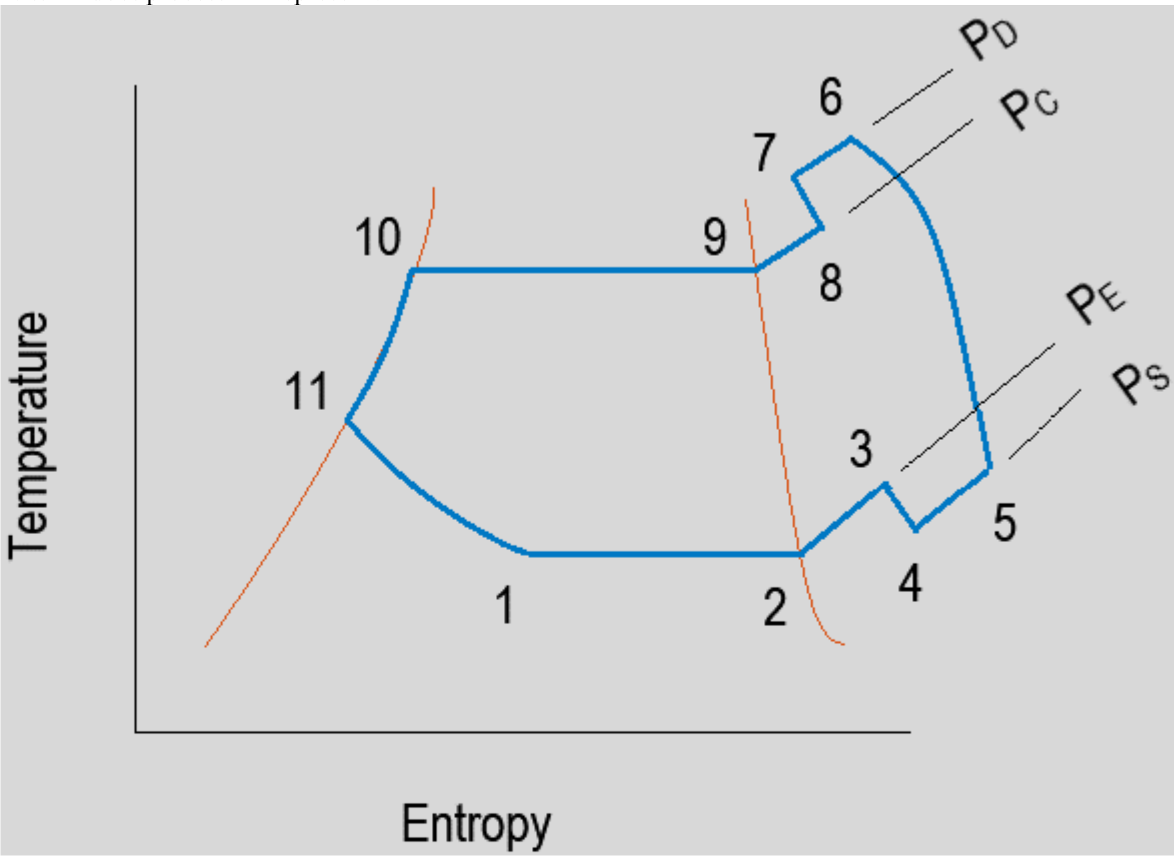
Answer: b
Explanation: The difference between the saturation temperature T_3 of liquid refrigerant at pressure $p_3 = p_2$ and the actual temperature of liquid refrigerant $T_{3â€²}$ is called degree of sub cooling or degree of undercooling i.e. (T_3 â€“ $T_{3â€²}$).

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œActual VCR Cycleâ€�.

1. Which of the following is not the difference between theoretical and actual VCR cycle?
a) Pressure drops in the evaporator
b) Pressure drops in the condenser
c) Compression of refrigerant is never polytropic
d) Compression of refrigerant is always isentropic

Answer: d
Explanation: Entropy is the randomness of molecules. Change in entropy cannot be kept constant. As any transfer of energy will provide energy to the particles and increasing the entropy. The entropy of the Universe tends to increase day by day. Hence, the compression process cannot be executed in an isentropic manner. Ideally, it can be assumed, but in the actual cycle, it is impossible to attain such a process.

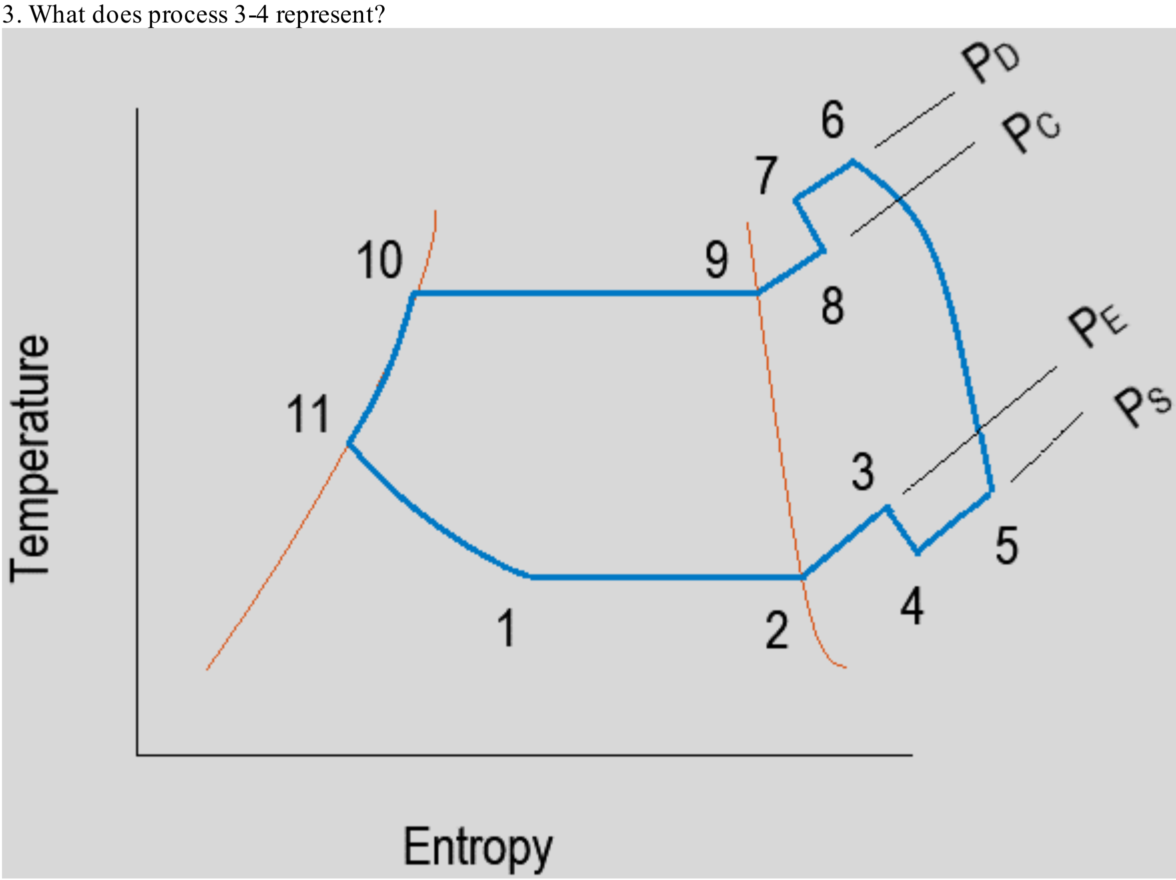
2. What does process 2-3 represent?



a) Compression
b) Condensation
c) Evaporation with superheating
d) Expansion with subcooling

Answer: c
Explanation: Process 2-3 represents evaporation with superheating. The shift of exit of evaporation from point 2 to point 3 is due to
1) Automatic control of expansion valve
2) Absorbs a larger amount of heat
3) Refrigeration effect and work increases.

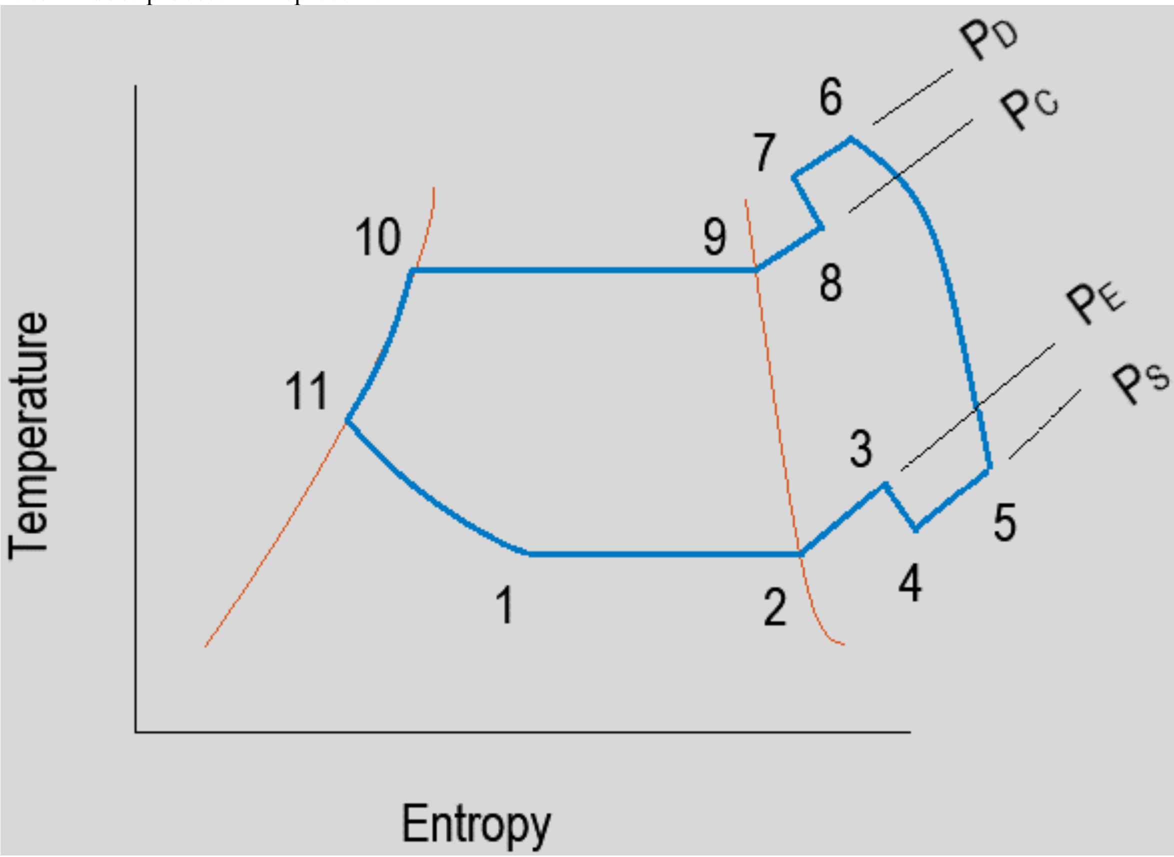
3. What does process 3-4 represent?



a) Pressure reduction
b) Compression
c) Condensation
d) Evaporation

Answer: a
Explanation: Due to the frictional resistance offered to the vapor refrigerant entering the compression system pressure drops from point 3 to point 4. Thus, actual suction pressure (P_S) lower than the evaporator pressure (P_E).

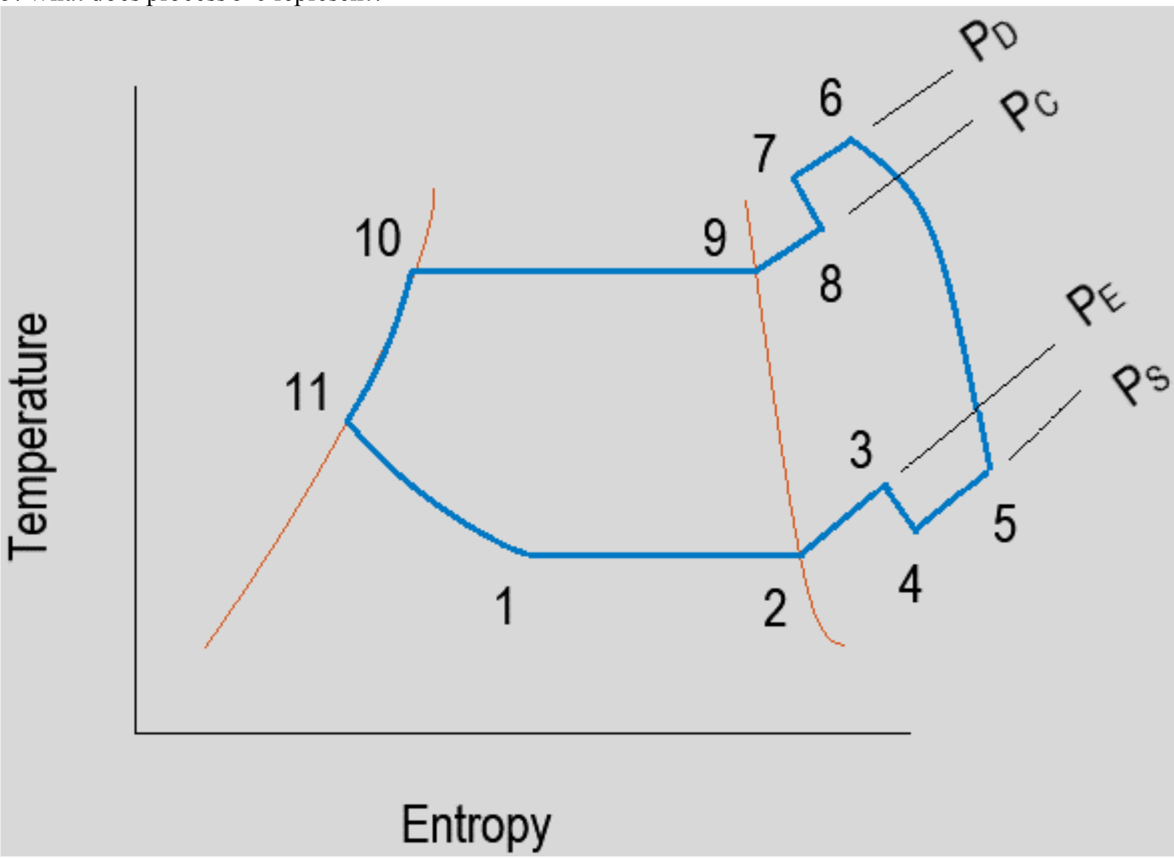
4. What does process 4-5 represent?



a) Temperature rise
b) Temperature fall
c) Compression
d) Expansion

Answer: a
Explanation: After pressure reduction and before compression begins, the temperature of cold refrigerant comes in contact with compression cylinder walls, which are at a higher temperature. Hence, due to heat transfer, the temperature of the refrigerant rises to point 5, which is the heating effect.

5. What does process 5-6 represent?

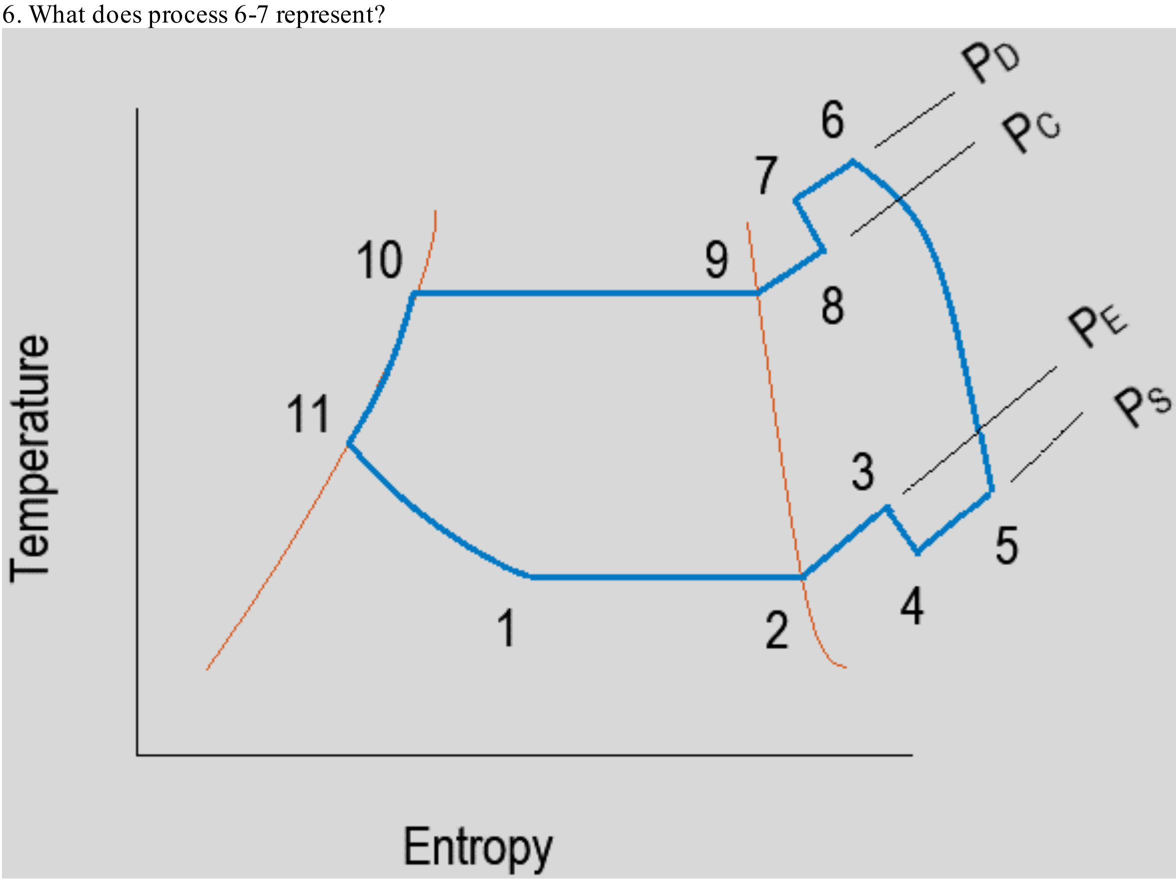


-

a) Expansion
b) Compression
c) Condensation
d) Evaporation

Answer: b
Explanation: Actual compression is denoted by process 5-6, which is neither isentropic nor polytropic, due to heat transfer between cylinder walls and vapor refrigerant. The temperature of cylinder walls is between cold suction vapor refrigerant and hot discharge vapor refrigerant. Pressure and temperature are increased in this process.

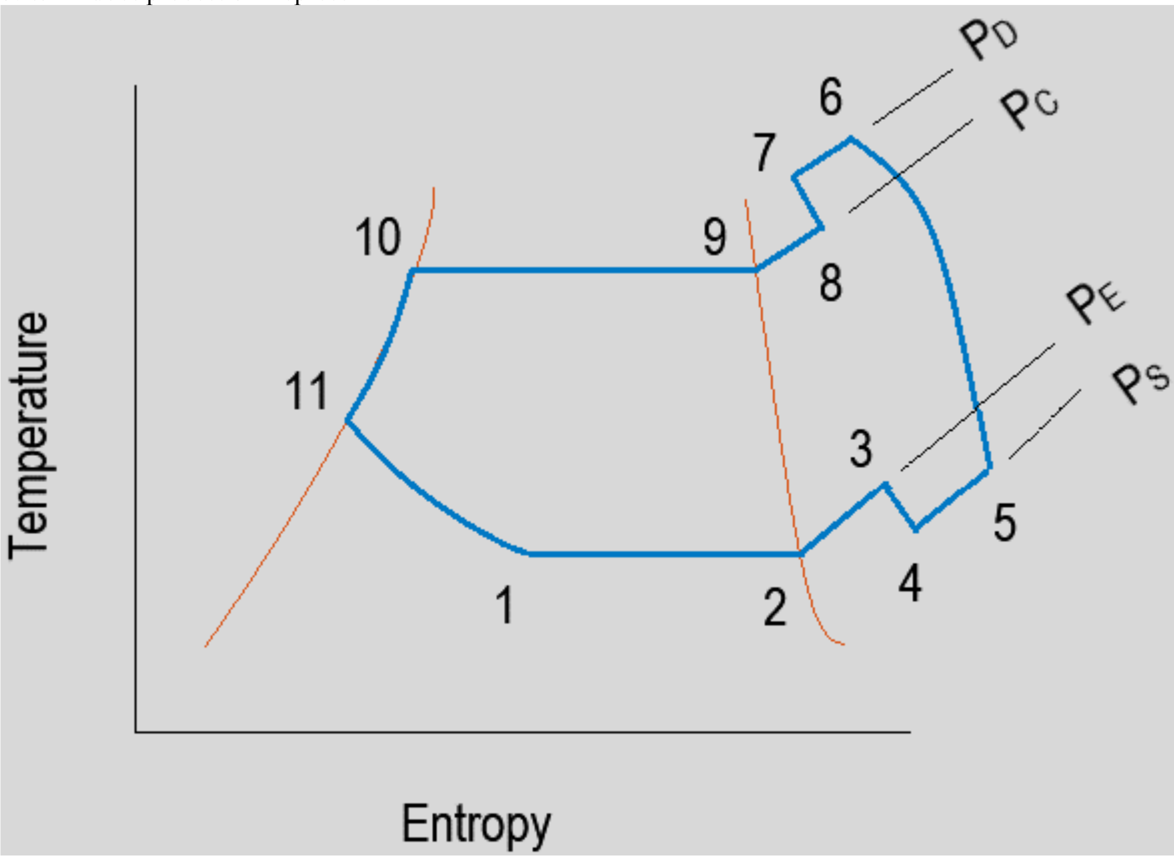
6. What does process 6-7 represent?



a) Temperature rise
b) Temperature fall
c) Compression
d) Expansion

Answer: b
Explanation: After compression and before Condensation begins, the temperature of hot refrigerant comes in contact with compression cylinder walls which are at a lower temperature. Hence, due to heat transfer, the temperature of the refrigerant falls to point 7, which is a cooling effect.

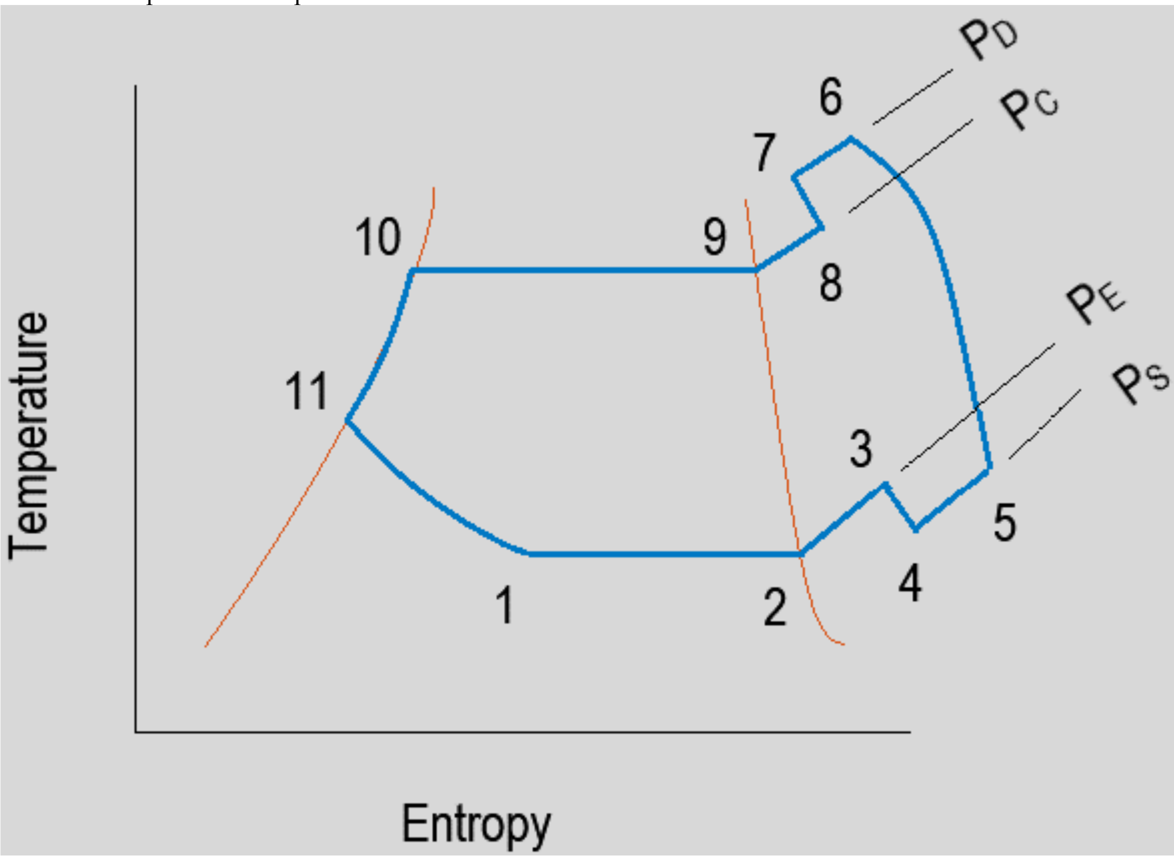
7. What does process 7-8 represent?



a) Condensation
b) Compression
c) Pressure reduction
d) Evaporation

Answer: c
Explanation: Due to the frictional resistance offered to the vapor refrigerant discharging the compression system pressure drops from point 7 to point 8. Thus, actual discharge pressure (P_D) higher than the condenser pressure (P_C).

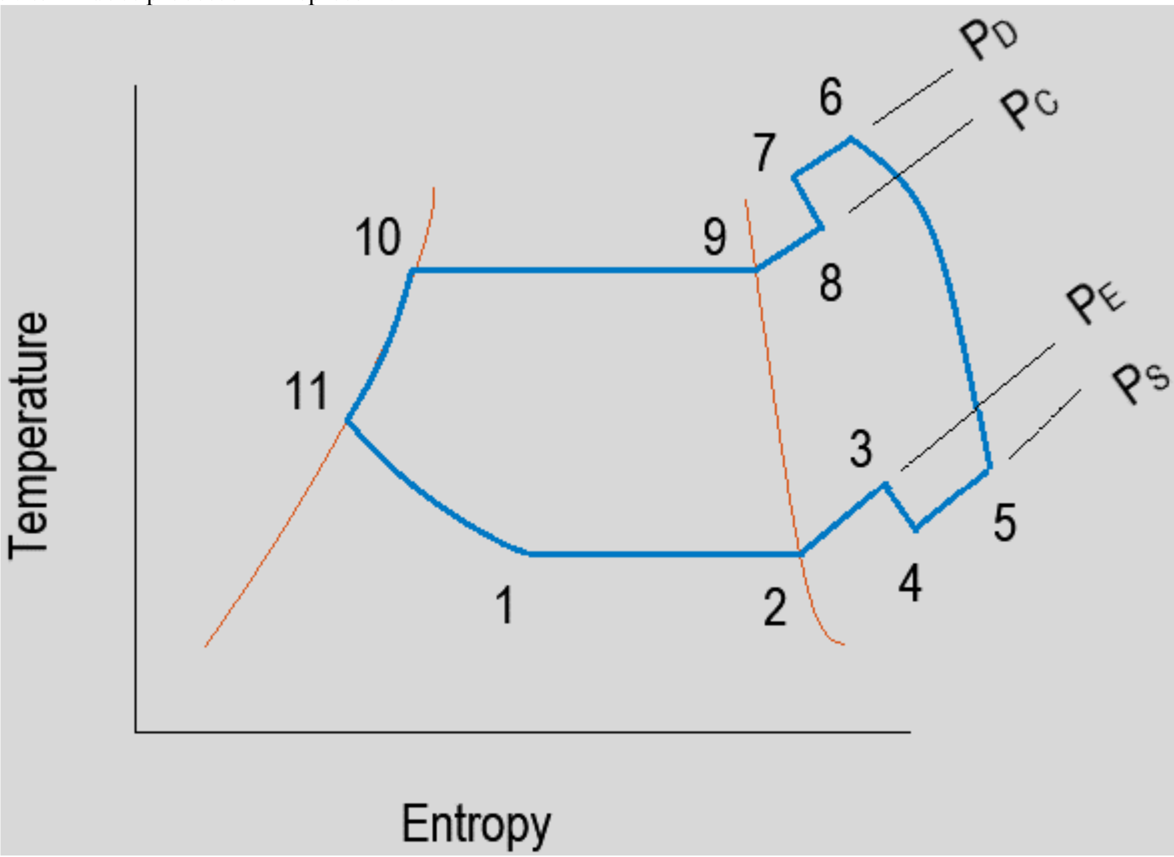
8. What does process 8-9 represent?



a) Compression
b) Condensation
c) De-superheating
d) Expansion with subcooling

Answer: c
Explanation: Before condensing the refrigerant, to reject maximum heat to get stabilized state of refrigerant, the refrigerant must be at saturated state before condensing. Hence, de-superheating is carried out to get the refrigerant at a saturated level and then condensed.

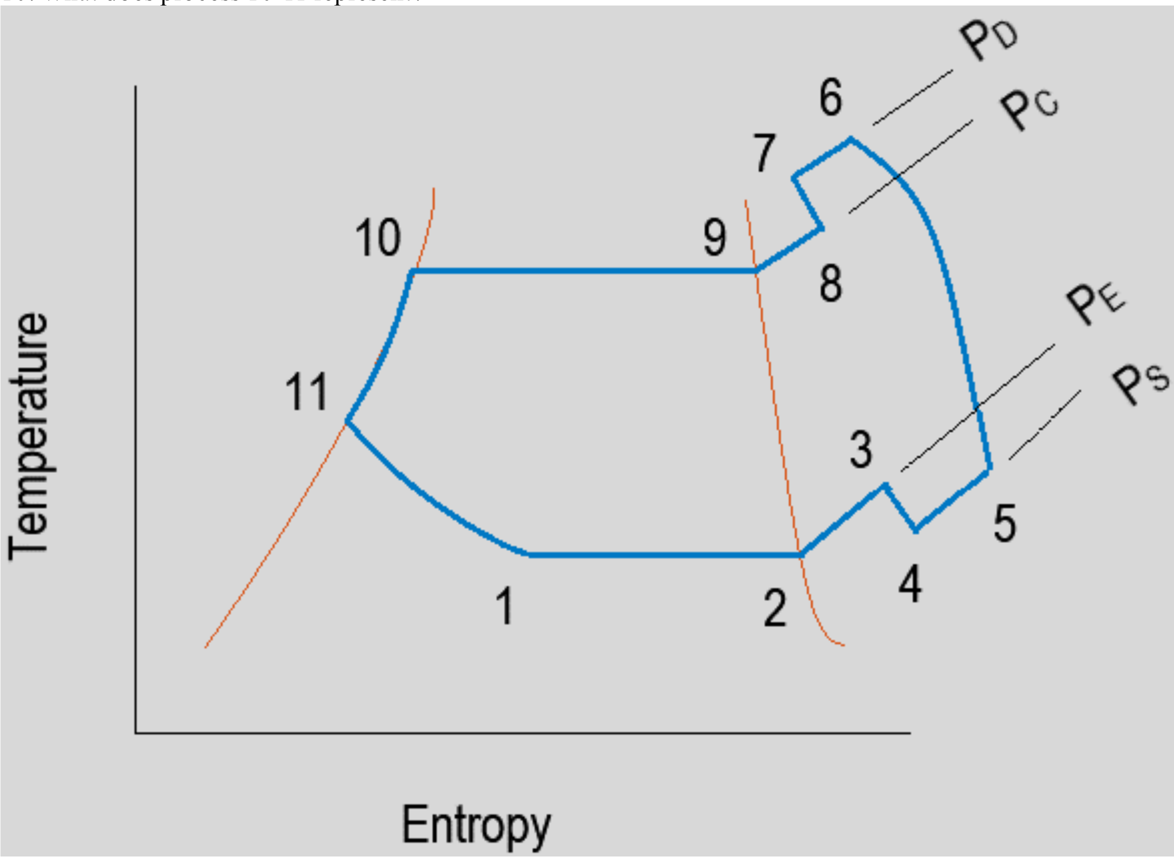
9. What does process 9-10 represent?



a) Compression
b) Condensation
c) Evaporation
d) Expansion

Answer: b
Explanation: Process 9-10 shows the removal of latent heat where the dry saturated refrigerant is converted into a liquid refrigerant. This process is called Condensation.

10. What does process 10-11 represent?

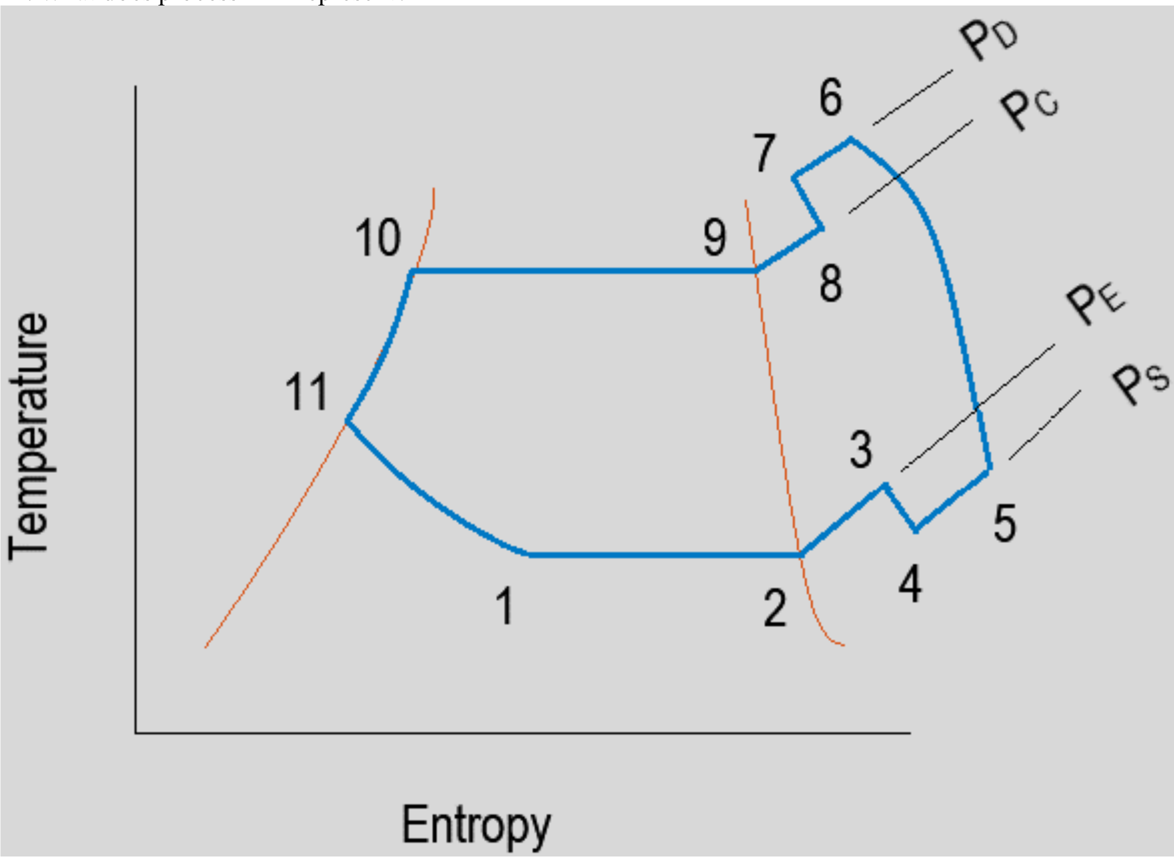


a) Compression

b) Expansion
c) Evaporation with superheating
d) Subcooling

Answer: d
Explanation: The process 10-11 represents sub-cooling of the liquid refrigerant in the condenser before it is expanded. Sub-cooling is carried out as it increases the refrigerating effect per kg of the refrigerant flow. It does reduce the volume of refrigerant partially evaporated from liquid refrigerant while going through the expansion valve. The refrigerating effect can be increased by circulating a large amount of water, which is at a much lower temperature than condensing temperature.

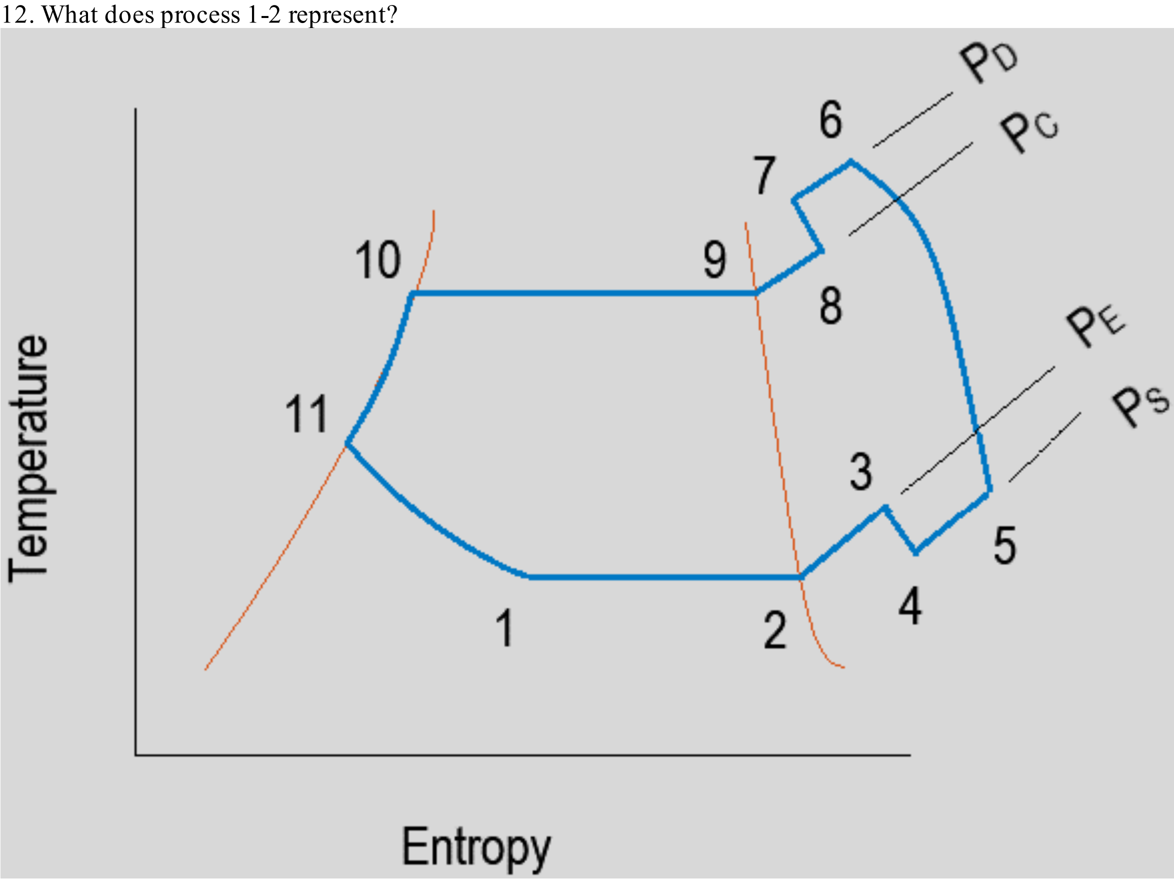
11. What does process 11-1 represent?



a) Expansion
b) Condensation
c) Compression
d) Evaporation

Answer: a
Explanation: Process 11-1 represents expansion. The expansion of sub-cooled liquid refrigerant is carried out by throttling (keeping enthalpy constant) from the condenser pressure to the evaporative pressure.

12. What does process 1-2 represent?



a) Expansion
b) Condensation
c) Compression
d) Evaporation

Answer: d
Explanation: Process 1-2 represents evaporation. In this process, absorption of heat is carried out and converting liquid refrigerant to saturated vapor condition. The evaporation process is known as Refrigeration effect.

13. What is the effect of a decrease in suction pressure on C.O.P.?
a) C.O.P. increases
b) C.O.P. decreases
c) C.O.P. remains the same
d) C.O.P. becomes zero

Answer: b
Explanation: As C.O.P. is the ratio of refrigeration effect to work done. Due to the decrease in the suction pressure, the refrigeration effect is decreases and work required for compression increases for the same amount of refrigerant flow. Hence, resulting in a reduction of the C.O.P. of the system and refrigeration cost also increases.

14. What is the effect of an increase in discharge pressure on C.O.P.?
a) C.O.P. decreases
b) C.O.P. increases
c) C.O.P. remains the same
d) C.O.P. becomes zero

Answer: a
Explanation: As C.O.P. is the ratio of refrigeration effect to work done. Due to the increase in the discharge pressure, the refrigeration effect decreases for the same amount of refrigerant flow. Hence, resulting in a small decrease in the C.O.P. of the system.

15. Which of the following factor of the actual VCR affects severely the coefficient of performance?
a) Increase in suction pressure
b) Decrease in discharge pressure
c) Decrease in suction pressure
d) Increase in discharge pressure

Answer: c
Explanation: As C.O.P. is the ratio of refrigeration effect to work done. Due to the increase in the discharge pressure, refrigeration effect decreases, but it is not that severe as is in the case of a decrease in suction pressure. Due to the decrease in the suction pressure, the refrigeration effect severely decreases, and work required for compression increases for the same amount of refrigerant flow. Hence, resulting in a severe decrease in the C.O.P. of the system and refrigeration cost also increases.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œEffect of Various Parameters on VCR System â€“ 1â€�.

1. Which of these is not an effect of superheat in suction vapour?
a) increase in refrigeration effect
b) increase in compression work
c) decrease the capacity of compressor per ton of refrigeration
d) condenser size decreases

Answer: d
Explanation: The effects of superheat in suction vapour are increase in refrigeration effect, increase in compression work, decreasing the capacity of compressor per ton of refrigeration and increasing the condenser size as the heat rejected in the condenser increases.

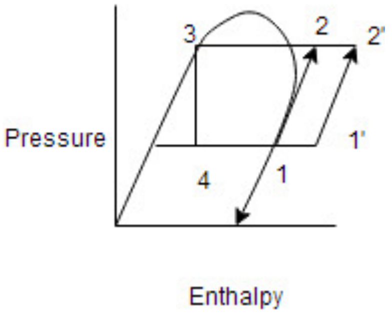
2. The COP of the cycle may increase or decrease or remain unchanged depending upon the range of pressure and the degree of superheating.
a) True
b) False

Answer: a
Explanation: The COP of the cycle may increase or decrease or remain unchanged depending upon the range of pressure and the degree of superheating as it can affect the refrigeration effect, compression work, heat rejected in condenser etc. and thus the COP.

3. In which case will the refrigeration effect will not increase and the COP of cycle with superheated vapour in suction phase will be less than the COP of ideal cycle?
a) Superheating the vapour from state 1 to 1â€²
b) Superheating the vapour from state 1 to 2
c) Superheating the vapour from state 1â€² to 2â€²

d) COP always increases when superheating vapour in suction vapour

Answer: a
Explanation: As we can see from the below picture of a cycle with superheated vapour in suction vapour, the refrigeration effect is not increased and thus the COP will be less than that of ideal COP.



4. Which one of the following is not effect of liquid sub cooling?
a) increase the refrigeration effect
b) reduce the piston displacement
c) increase the COP
d) increase the compressor power per ton of refrigeration

Answer: d
Explanation: Sub cooling the liquid reduces the compressor power per ton of refrigeration due to reduced mass flow rate of refrigerant. It also increases the refrigeration effect, reduce the piston displacement and increase the COP.

5. Which one of the following is not effect of change in suction pressure?
a) reduces the net refrigeration effect
b) reduces the mass flow rate of refrigerant per ton of refrigeration
c) reduces the COP

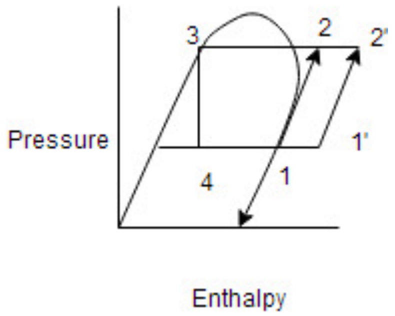
d) increases the compressor power per ton of refrigeration

Answer: b
Explanation: Change in suction pressure reduces the net refrigeration effect thus increasing the mass flow rate of refrigerant per ton of refrigeration.

6. Effect of high side pressure or discharge pressure or condenser pressure is to reduce the COP of the cycle.
a) True
b) False

Answer: a
Explanation: Effect of high side pressure or discharge pressure or condenser pressure is to reduce the COP of the cycle as the refrigeration effect is reduced and the compression work increases as well as the compressor power increases per ton of refrigeration due to increased mass flow and additional energy supplied in compression.

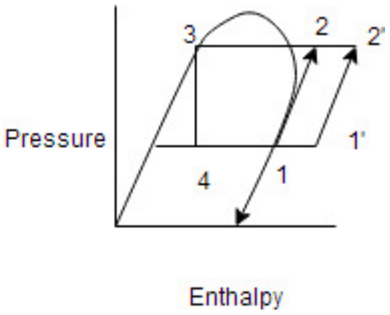
7. Heat rejected in the condenser increases by an amount equal to, when vapour in the suction vapour is superheated?



a) H_2 â€“ H_2â€²
b) H_2 + H_2â€²

c) H 2â€² â€“ H 2
d) H 2â€² + H 2

Answer: c
Explanation: As we see from the below diagram the heat rejected in the condenser increases by an amount equal to H 2â€² â€“ H 2 .

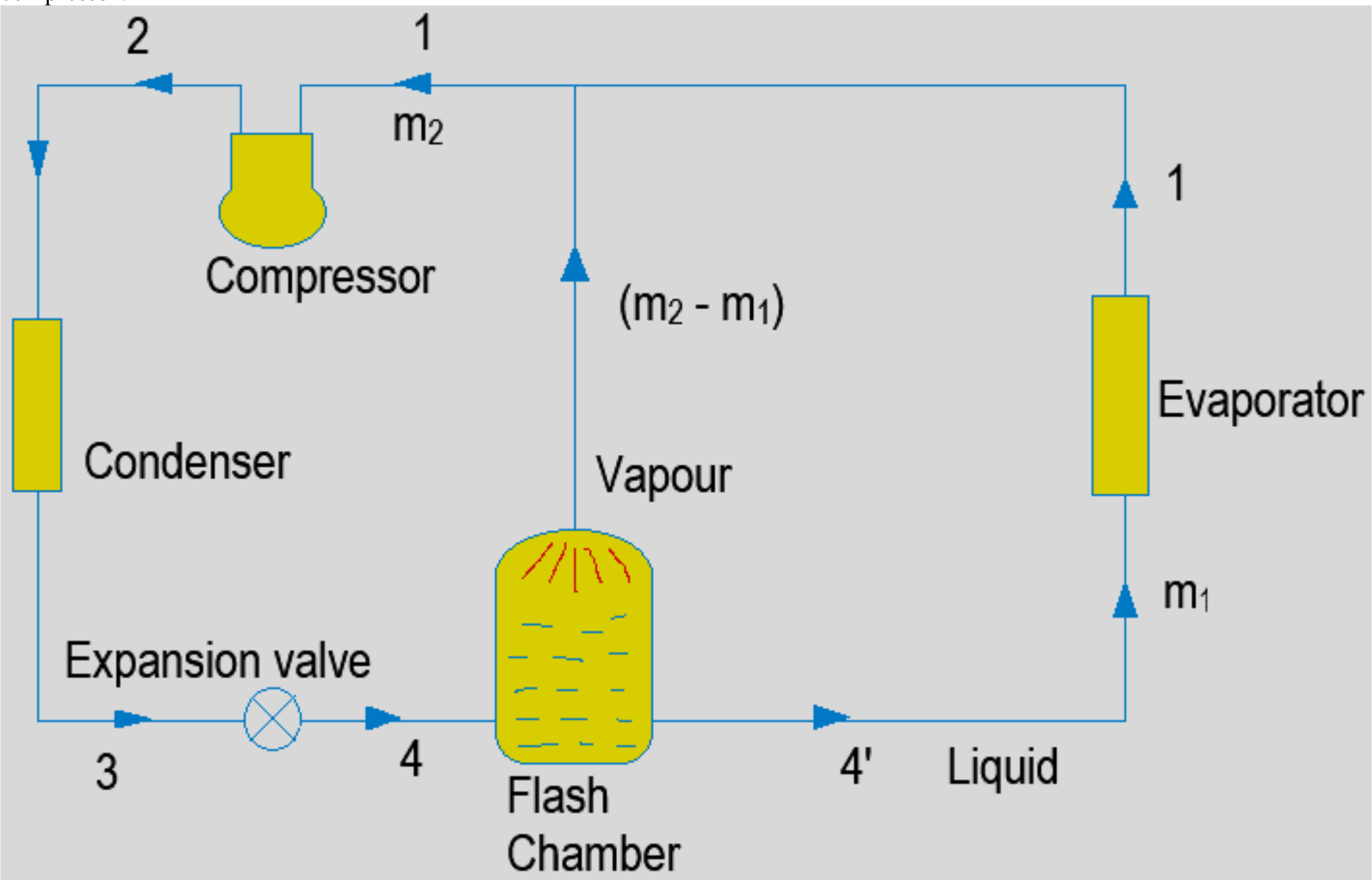


This set of Refrigeration MCQs focuses on â€œEffect of Various Parameters on VCR System â€“ 2â€�.

1. What is the use of a flash chamber in VCR system?
a) To increase pressure
b) To decrease pressure
c) To separate vapour and liquid refrigerant
d) To evaporate refrigerant partially

Answer: c
Explanation: Flash chamber is used to separate vapour and liquid refrigerant. It is an insulated container and separates both forms by using the centrifugal effect.

2. What is the amount of mass of vapour refrigerant flowing directly from flash chamber to suction of the compressor?



a) m_1

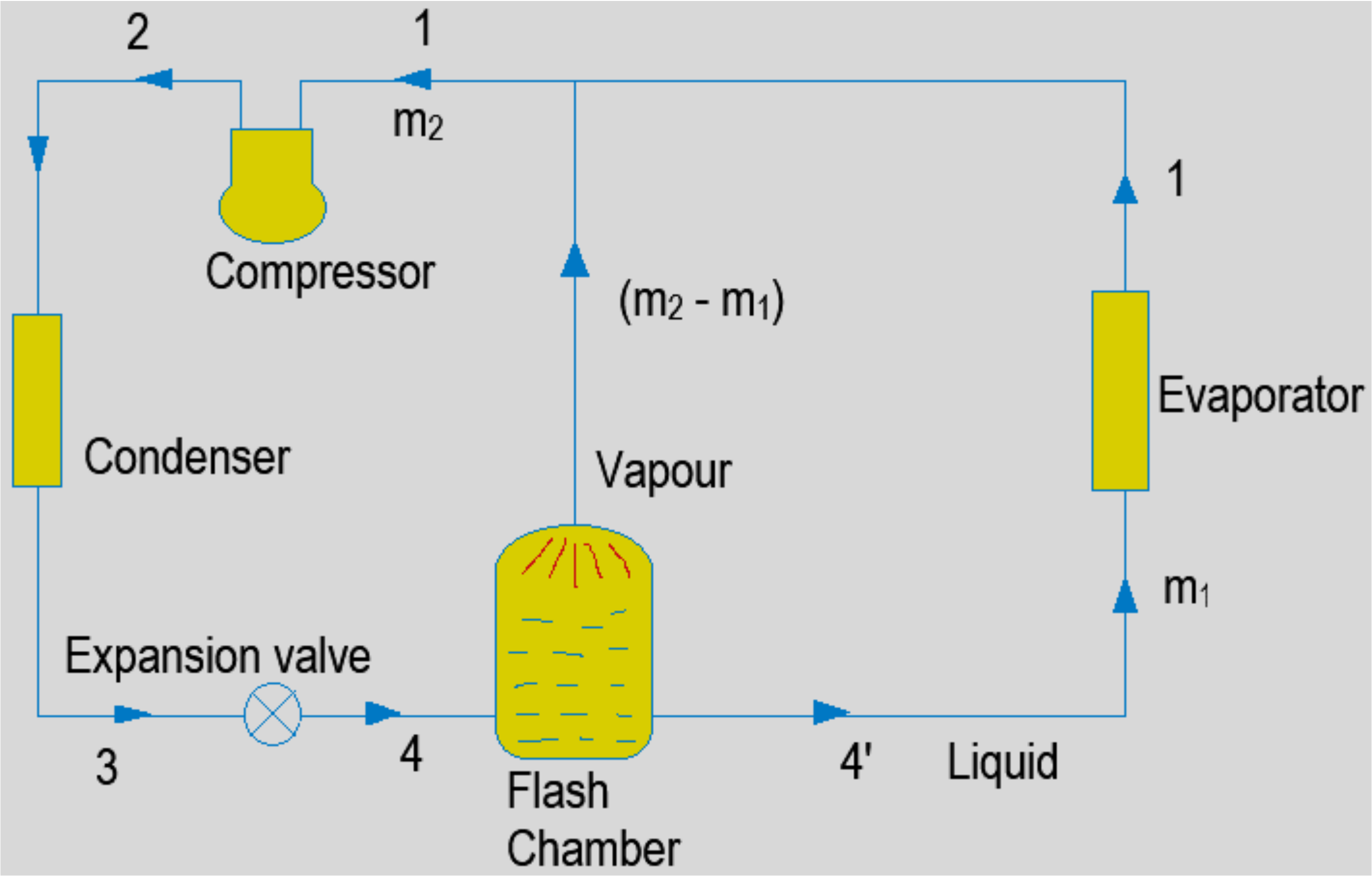
b) m_2

c) $m_1 + m_2$

d) m_2 â€“ m_1

Answer: d
Explanation: As, m_1 = Mass of the liquid refrigerant supplied to the evaporator
m_2 = Mass of refrigerant (liquid and vapour) circulating through the condenser
Hence, the amount of mass flowing through the flash chamber to the compressor is given by,
= m_2 â€“ m_1 .

3. What is the ratio of the mass of refrigerant supplied to evaporator and mass of refrigerant circulating through condenser i.e., m_1 / m_2 ?



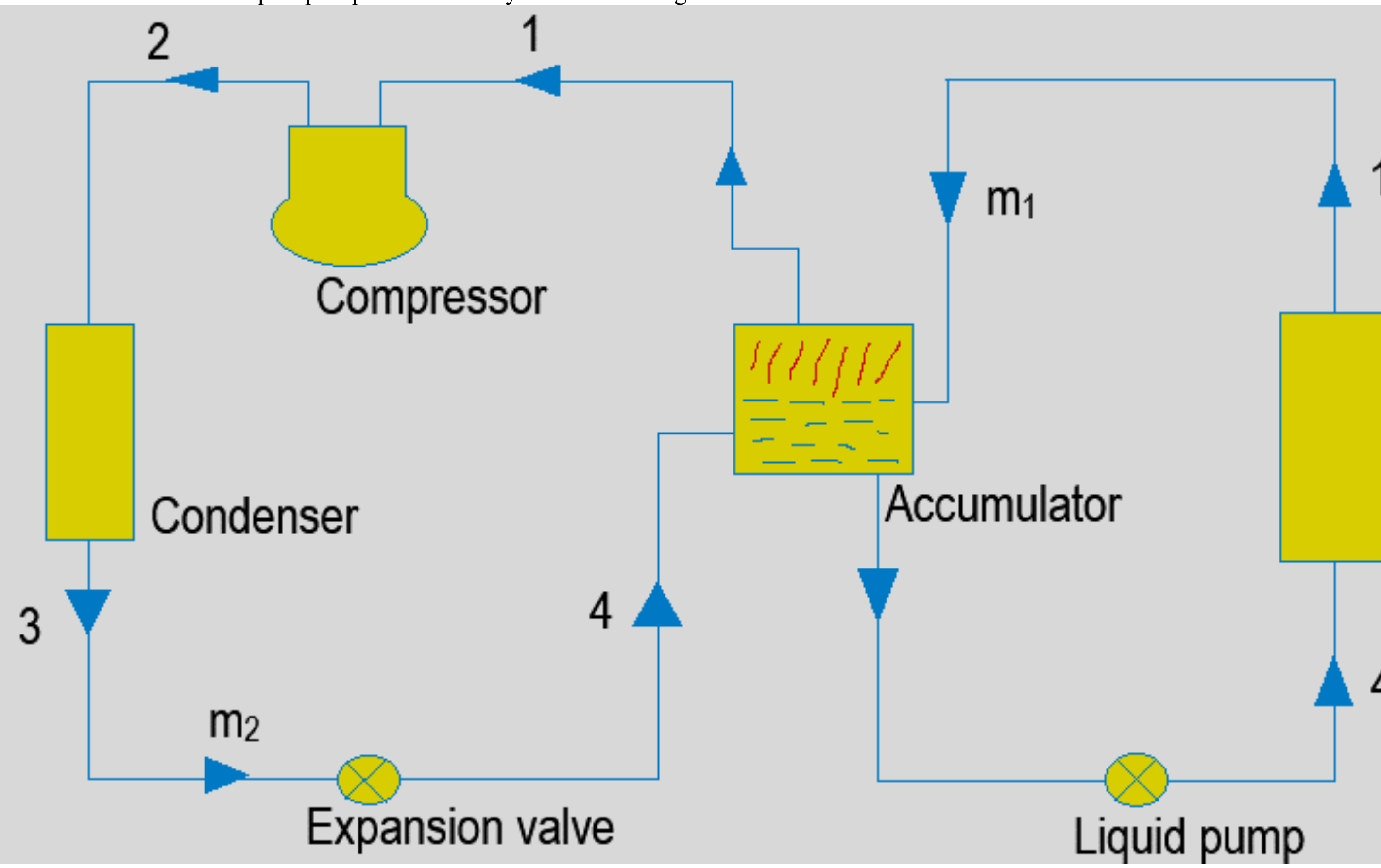
a) h_1 â€“ h_2 / h_1 â€“ h_4
b) h_1 â€“ h_4 / h_1 â€“ h_{f4}â€™
c) h_2 â€“ h_1 / h_4 â€“ h_1
d) h_1 â€“ h_{f4}â€™ / h_1 â€“ h_4

Answer: b
Explanation: As flash chamber is an insulated cylinder. Heat transfer between flash chamber and surroundings is zero. So, by considering thermal equilibrium of flash chamber,
Heat taken by the flash chamber = Heat given out by the flash chamber
$m_2 h_4 = m_1 h_{f4}$â€™ + (m_2 â€“ m_1) h_1
m_2 (h_1 â€“ h_4) = m_1 (h_1 â€“ h_{f4}â€™)
m_1 / m_2 = [h_1 â€“ h_4 / h_1 â€“ h_{f4}â€™].

4. What is the use of accumulator or pre-cooler in VCR system?
a) To supply dry saturated vapour and pure liquid refrigerant to the respective equipment
b) To decrease pressure
c) To increase pressure
d) To condense refrigerant partially

Answer: a
Explanation: Accumulator or pre-cooler does almost the same work as a flash chamber. It receives the discharge of a mixture of liquid and vapour refrigerant from expansion valve and supplies liquid refrigerant only to the evaporator. This discharge again sent to the accumulator, and only dry saturated vapour refrigerant is further sent to the compressor.

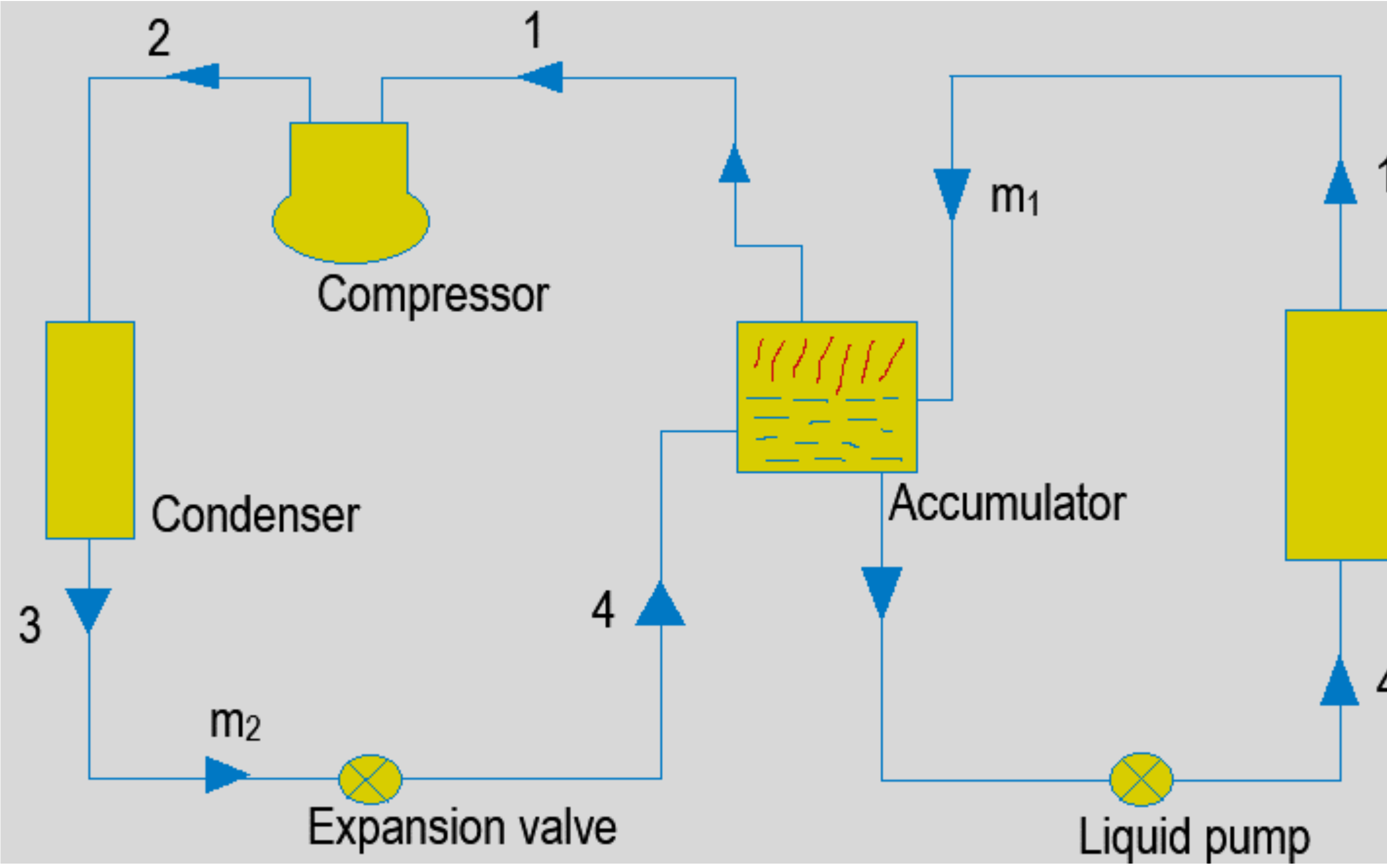
5. What is the use of a liquid pump in the VCR system containing accumulator?



a) To maintain the circulation of the refrigerant
b) To provide liquid refrigerant
c) To expand the liquid refrigerant
d) To pre-evaporate the liquid refrigerant

Answer: a
Explanation: Accumulator separates the mixture of refrigerants, and provides dry saturated vapour to the compressor and pure liquid refrigerant to the evaporator. So, to maintain the circulation of the liquid refrigerant in the evaporator, a liquid pump is used.

6. What is the ratio of the mass of refrigerant supplied to evaporator and mass of refrigerant circulating through condenser i.e., m_1 / m_2 ?

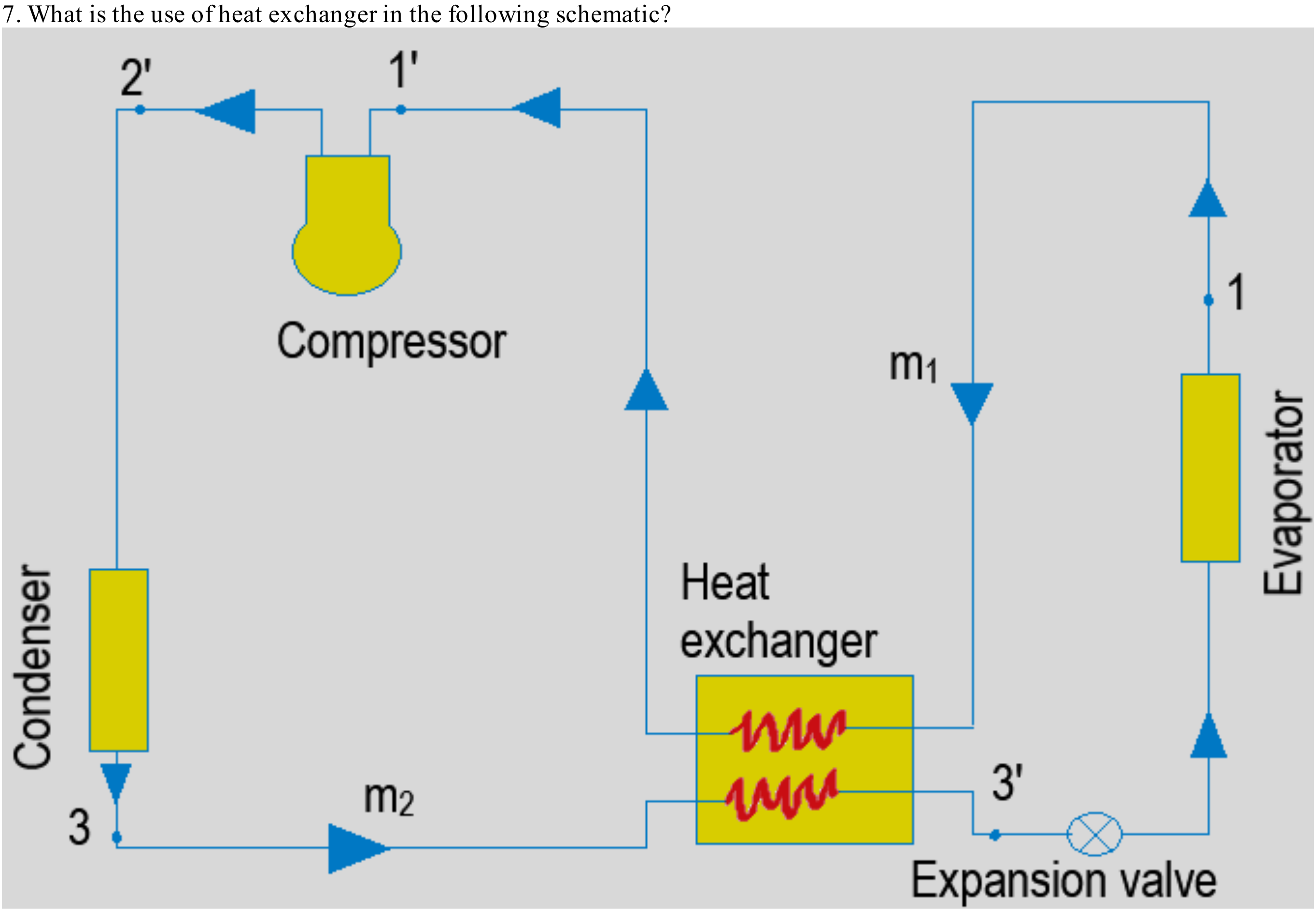


a) h_1 âˆ’ h_2 / h_1 âˆ’ h_4
b) h_1 âˆ’ h_4 / h 1â€™ âˆ’ h f4â€™
c) h_2 âˆ’ h_1 / h_4 âˆ’ h_1
d) h 1â€™ âˆ’ h f4â€™ / h_1 âˆ’ h_4

Answer: b
Explanation: As accumulator is an insulated vessel. Heat transfer between flash chamber and surroundings is zero.

So, by considering thermal equilibrium of flash chamber,
Heat taken by the accumulator = Heat given out by the accumulator
$m_2 h_4 + m_1 h_{1\text{â€™}} = m_2 h_1 + m_1 h_{f4\text{â€™}}$
$m_1 (h_{1\text{â€™}} \text{ âˆ’ } h_{f4\text{â€™}}) = m_2 (h_1 \text{ âˆ’ } h_4)$
$m_1 / m_2 = [h_1 \text{ âˆ’ } h_4 / h_{1\text{â€™}} \text{ âˆ’ } h_{f4\text{â€™}}]$.

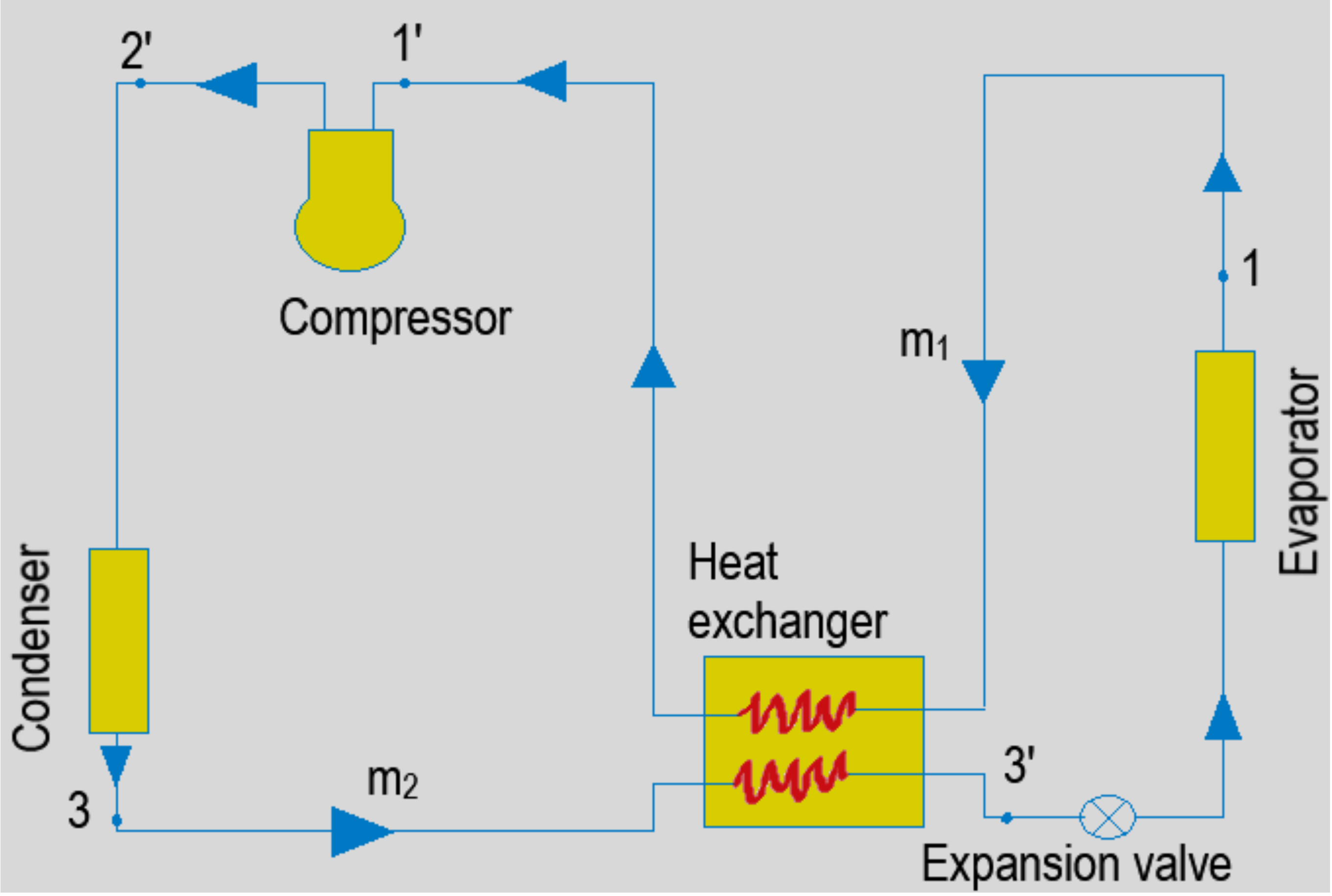
7. What is the use of heat exchanger in the following schematic?



a) Compression
b) Expansion
c) Subcooling of liquid by vapour refrigerant
d) Subcooling of vapour by liquid refrigerant

Answer: c
Explanation: Liquid leaves condenser at a higher temperature than vapour leaving the evaporator. So, liquid refrigerant leaving the condenser is able to be subcooled by passing it through a heat exchanger which is supplied with the vapour refrigerant from the evaporator. Hence, this heat exchanger is used to do the subcooling of liquid refrigerant by the vapour refrigerant.

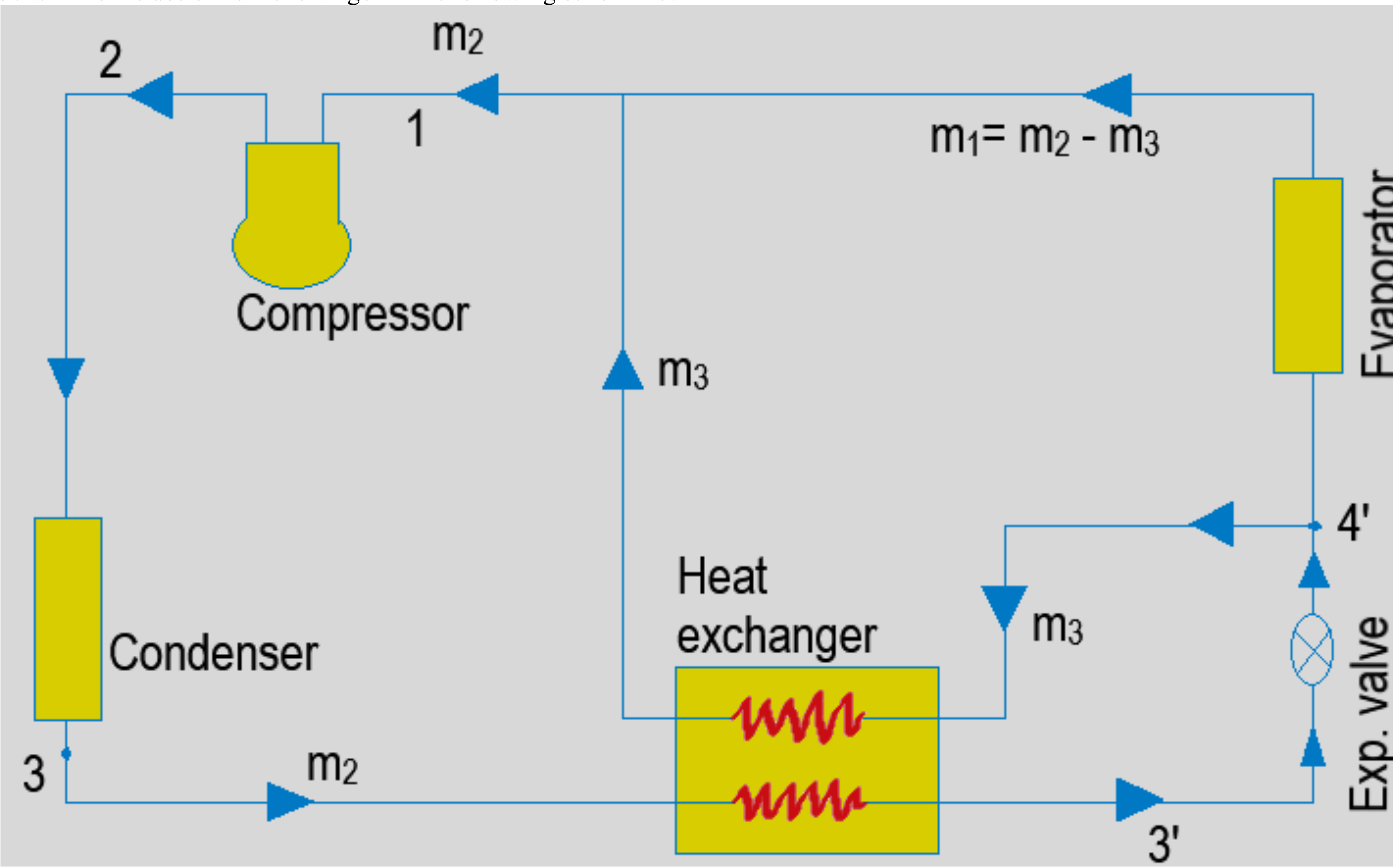
8. What is the ratio of the mass of the vapour refrigerant and mass of the liquid refrigerant i.e., m_1 / m_2 ?



a) 1
b) h 1 âˆ' h 4 / h 1â€™ âˆ' h f4â€™
c) 0
d) h 1â€™ âˆ' h f4â€™ / h 1 âˆ' h 4

Answer: a
Explanation: In the case of this kind of heat exchanger, heat transfer takes place between vapour and liquid refrigerant due to the change of temperature and specific heat. As the mass flowing through condenser and evaporator is same. Due to heat transfer, mass does not get affected. Hence,
$m_1 = m_2$ or $m_1 / m_2 = 1$.

9. What is the use of heat exchanger in the following schematic?

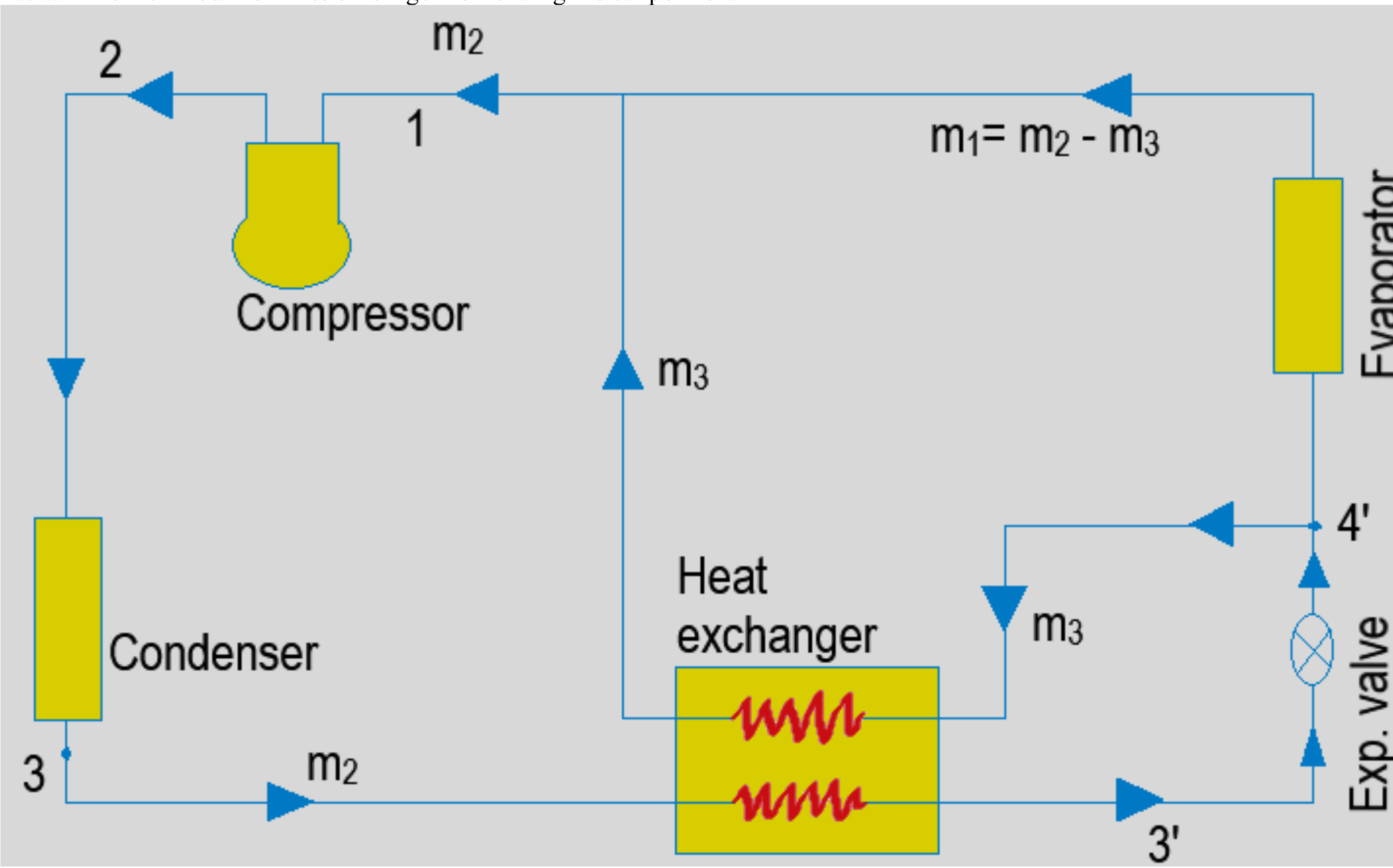


a) Compression
b) Subcooling of liquid by liquid refrigerant

c) Subcooling of liquid by vapour refrigerant
d) Subcooling of vapour by liquid refrigerant

Answer: b
Explanation: Liquid leaves the condenser at a higher temperature than liquid leaving the expansion valve. So, the liquid refrigerant leaving the condenser is able to be subcooled by passing through the heat exchanger which is supplied with the liquid refrigerant from the expansion valve. Hence, a heat exchanger is used to do the subcooling of liquid refrigerant at a higher temperature by the liquid refrigerant at a lower temperature.

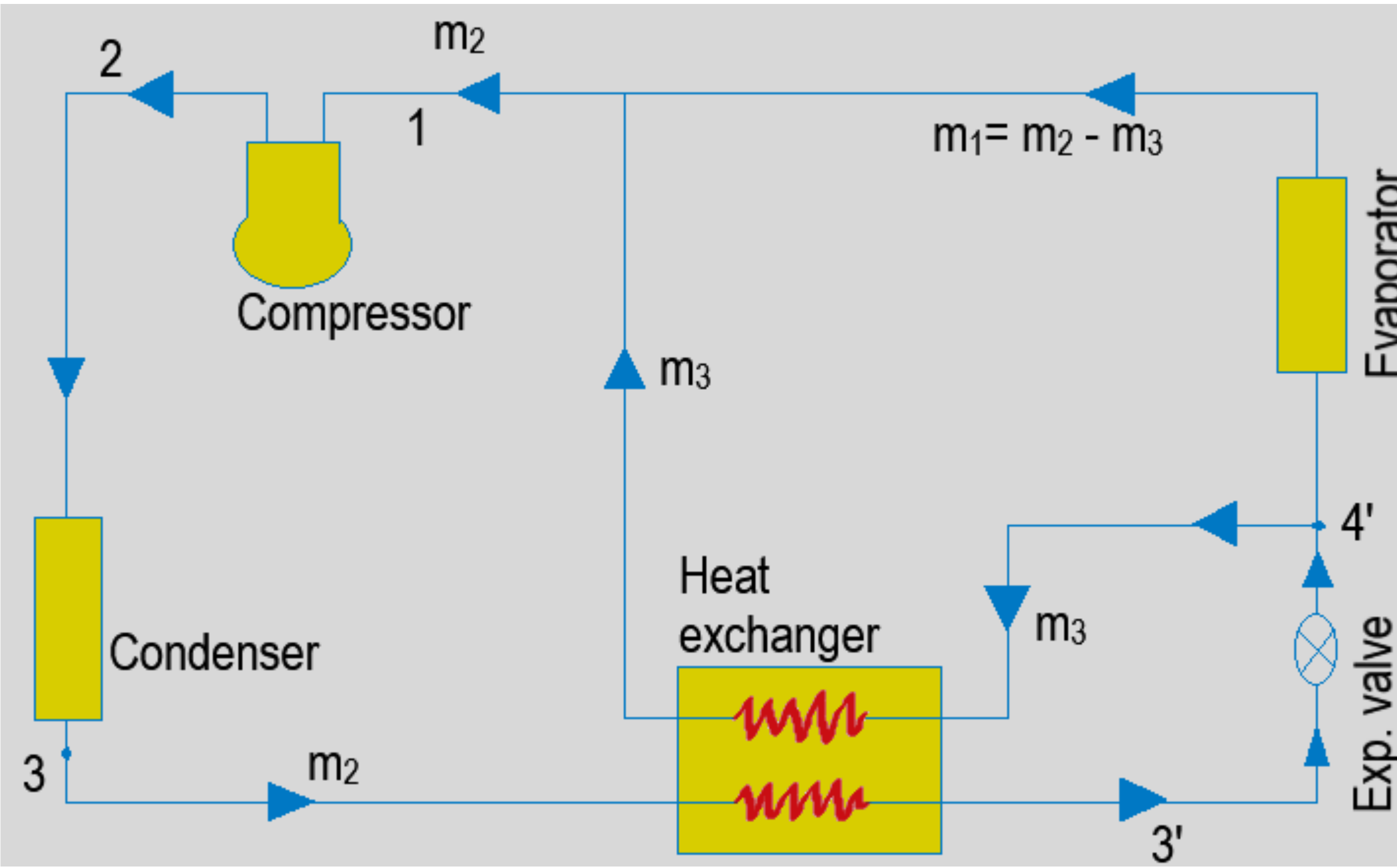
10. What is the amount of mass of refrigerator leaving the evaporator?



a) m_2 âˆ’ m_1
b) m_1 âˆ’ m_3
c) $m_2 + m_3$
d) m_2 âˆ’ m_3

Answer: d
Explanation: As, m_1 = Mass of refrigerant leaving the evaporator
m_2 = Mass of liquid refrigerant passing through the condenser
m_3 = Mass of liquid refrigerant supplied to the heat exchanger from the expansion valve
By taking the help of schematic,
Mass of refrigerator leaving the evaporator, $m_1 = m_2$ âˆ’ m_3 .

11. What is the ratio of the mass of liquid refrigerant passing through the condenser and mass of liquid refrigerant supplied to the heat exchanger i.e., m_3 / m_2 ?



a) h_1 âˆ’ h_2 / h_1 âˆ’ h_4
b) h_1 âˆ’ h_4 / $h_{\text{1â€™}}$ âˆ’ $h_{\text{f4â€™}}$
c) h_{f3} âˆ’ $h_{\text{f3â€™}}$ / h_1 âˆ’ $h_{\text{f4â€™}}$
d) h_1 âˆ’ $h_{\text{f4â€™}}$ / h_{f3} âˆ’ $h_{\text{f3â€™}}$

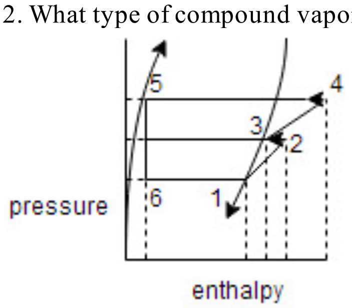
Answer: c
Explanation: Considering the thermal equilibrium of the heat exchanger,
Heat lost by liquid refrigerant from condenser = Heat gained by liquid refrigerant from expansion valve
$m_2 h_{f3} + m_3 h_{\text{f4â€™}} = m_3 h_1 + m_2 h_{\text{f3â€™}}$
m_2 (h_{f3} âˆ’ $h_{\text{f3â€™}}$) = m_3 (h_1 âˆ’ $h_{\text{f4â€™}}$)
m_3 / m_2 = [h_{f3} âˆ’ $h_{\text{f3â€™}}$ / h_1 âˆ’ $h_{\text{f4â€™}}$].

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œTwo/Multi Stage Compression with Liquid Intercooling â€“ 1â€�.

1. Which one of the following is not an advantage of compound vapor compression with intercooler?
a) It improves the volumetric efficiency for the given pressure ratio
b) It reduces the leakage losses
c) It provides effective lubrication
d) It does not give a uniform torque

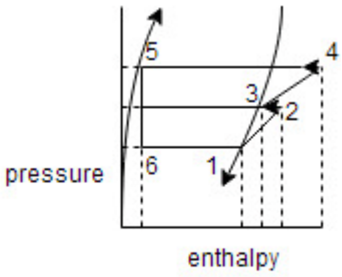
Answer: d
Explanation: One of the advantages of compound vapor compression with intercooler is that it gives more uniform torque, and hence a smaller size flywheel is needed. Some other advantages are that it improves the volumetric efficiency for the given pressure ratio, it reduces the leakage losses, it provides effective lubrication, etc.

2. What type of compound vapor compression is the following diagram of?



a) Two stage vapor compression with liquid intercooler
b) Three stage vapor compression with liquid intercooler
c) Two stage vapor compression with flash intercooler
d) Three stage vapor compression with flash intercooler

Answer: a
Explanation:



The diagram itself shows that it consists of two stage vapor compression with liquid intercooler from the process (1 â€“ 2) and (3 â€“ 4). For three stages there would have been three such processes.

3. Liquid refrigerant is used for inter cooling commonly in multi stage ammonia plants.
a) True
b) False

Answer: a
Explanation: Liquid refrigerant is used for inter cooling commonly in multi stage ammonia plants, because of less power requirements due to the fact that the mass of liquid evaporated during intercooling is extremely small because of its latent heat of vaporization and the constant entropy lines of ammonia becomes very flat in the superheat region.

4. Liquid refrigerant is not used for inter cooling in multi stage R- 12 plants.
a) True
b) False

Answer: a
Explanation: In case of R â€“ 12 refrigerants, when liquid refrigerant is used for intercooling the total power requirement may increase. It is due to the fact that latent heat of vaporization is small and the constant entropy lines do not change very much with temperature.

5. A compound vapour compression with an intercooler system is used to take 10 TR of refrigeration load (Q). The power required for the refrigerating system P is 550 KW. What is its COP?
a) 0.078
b) 0.086
c) 0.063
d) 0.089

Answer: c
Explanation: COP = \(\frac{210Ã—Q}{PÃ—60}\)

COP = \(\frac{210Ã—10}{550Ã—60}\)
= 0.063.

6. Which of the following is not a disadvantage of multiple compressions with intercooling between the stages?
a) Increases the initial cost
b) Size of plant increases
c) Increases the maintenance cost
d) Cylinder wall thickness of low pressure cylinder is increased

Answer: d
Explanation: The cylinder wall thickness of low pressure cylinder is reduced, since it is designed to withstand low pressure only. It reduces the cost of the compressor.

7. Why intercooling by liquid refrigerant never used in R-12 systems?
a) High latent heat of vaporization
b) Low latent heat of vaporization
c) Medium latent heat of vaporization
d) High toxicity

Answer: b
Explanation: In the case of refrigerant R-12, power requirements may increase. Due to the low latent heat of vaporization and constant entropy lines not getting affected by temperature, the increased mass flow rate of refrigerant through the high-pressure compressor is not compensated by saving in work done close to the saturated vapor line. This might result in a high power requirement and decreasing the C.O.P. Hence, intercooling by the liquid refrigerant in R-12 systems is never employed.

8. The refrigeration effect produced by a system is 10 TR and work done by the low-pressure compressor, and high-pressure compressor is 3 and 4 kW respectively. What is the value of C.O.P. for the given conditions?
a) 8.75
b) 11.67
c) 3.5
d) 5

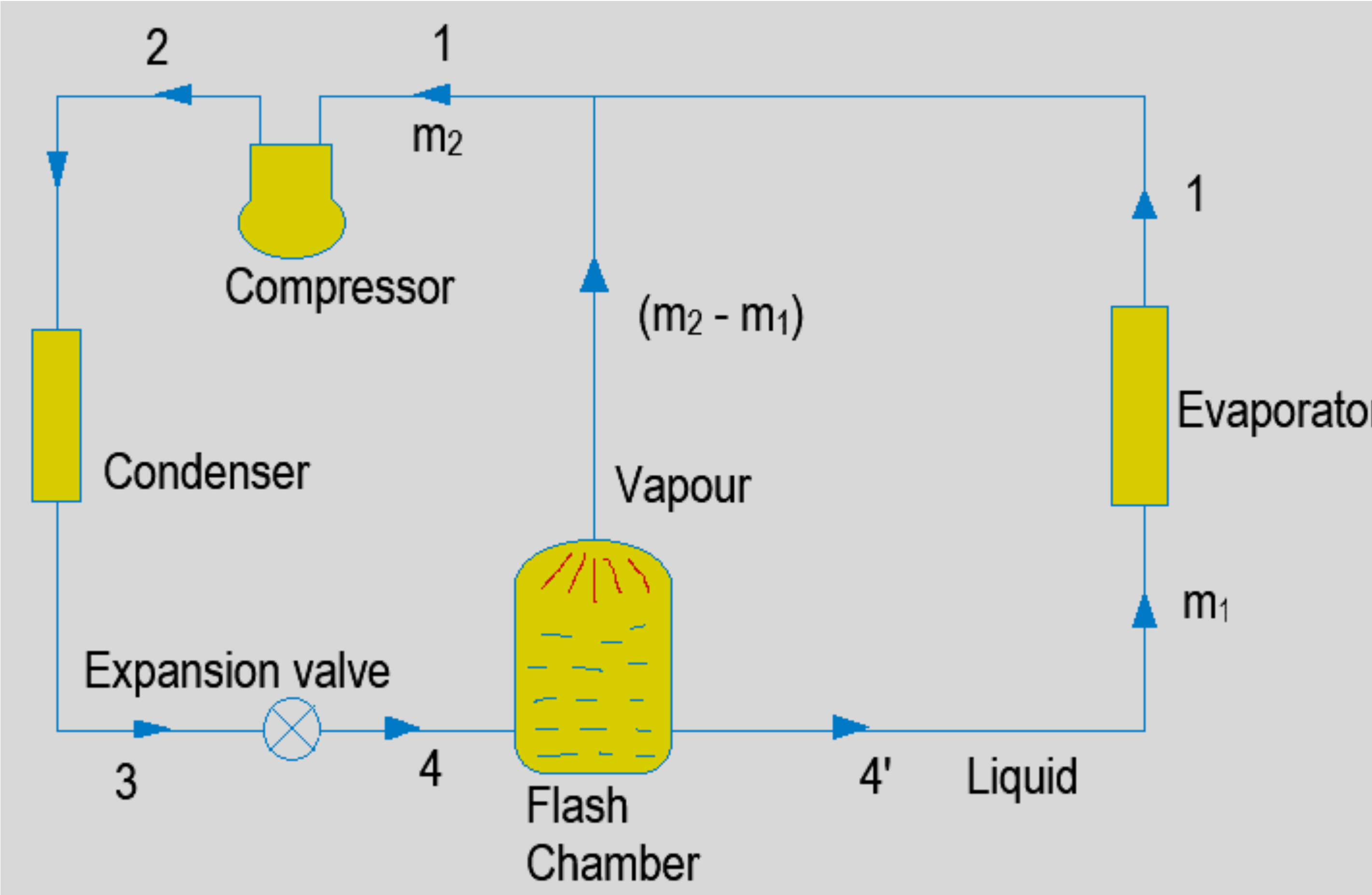
Answer: d
Explanation: Given: R.E. = 10 TR = 10 x 3.5 = 35 kW
Low-pressure compressor work, W_L = 3 kW
High-pressure compressor work, W_H = 4 kW
C.O.P. = R.E. / Total Work
= R.E. / $W_L + W_H$
= 35 / (3 + 4)
= 35 / 7
= 5.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œSimple VCR System â€“ Pressure â€“ Enthalpy Chartâ€�.

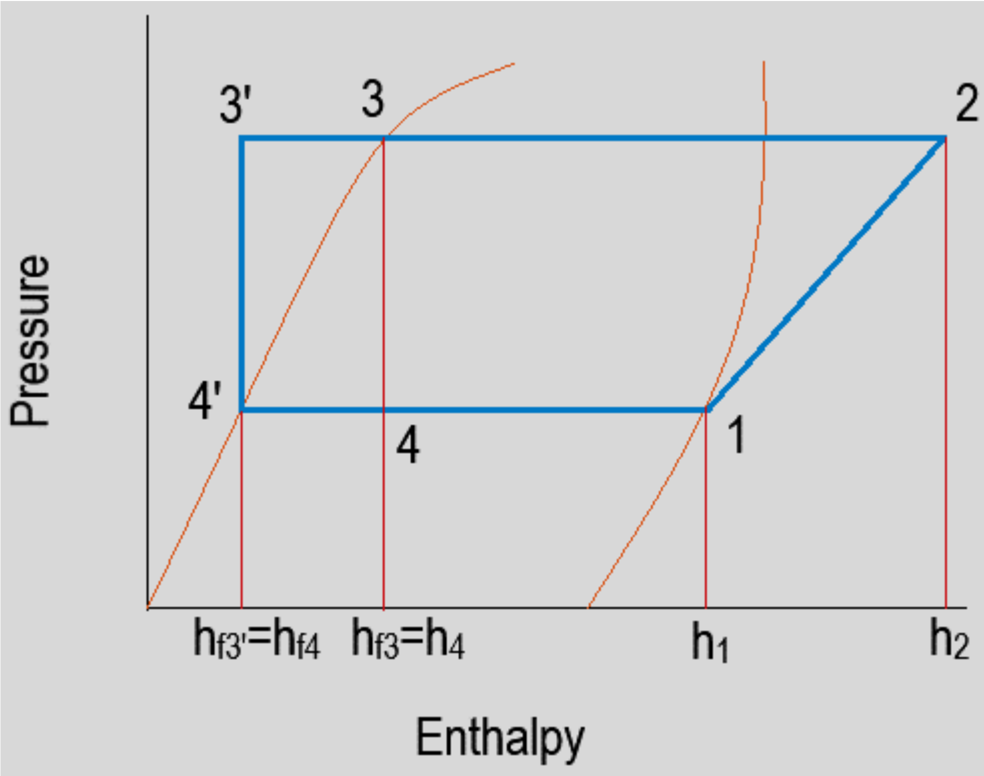
1. What is the effect of using a flash chamber in VCR system?
a) C.O.P. increases
b) C.O.P. decreases
c) C.O.P. remains the same
d) Mass of refrigerant flowing through evaporator increases

Answer: c
Explanation: As C.O.P. of the VCR system containing flash chamber is given by,
C.O.P. = h_1 âˆ’ h_{f3} / h_2 âˆ’ h_1
Which is same as the simple VCR cycle. The purest forms of refrigerant enter the respective system but effectively do not give enormous impact on C.O.P., So C.O.P. remains the same.
The mass of refrigerant required to flow through the evaporator decreases as even the smaller amount can produce the same refrigeration effect from its pure liquid form, resulting in a reduction in the size of evaporator.

2. From the following line diagram and p-h chart, what is the refrigeration effect in terms of the mass of mixture i.e., m_2 ?



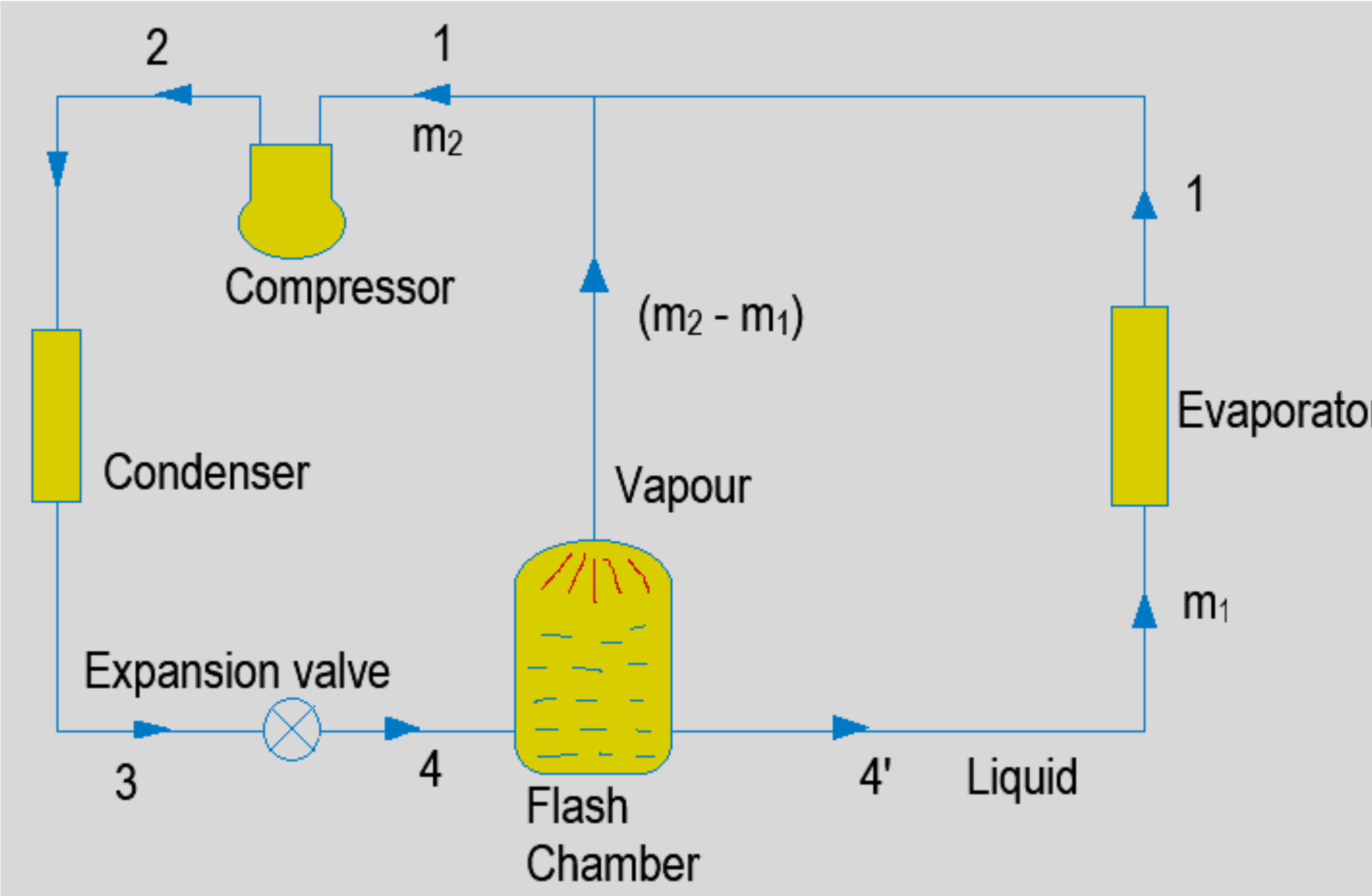
2
1
m_2
Compressor
1
$(m_2 - m_1)$
Evaporator
Condenser
Vapour
m_1
Expansion valve
3
4
4'
Liquid
Flash
Chamber

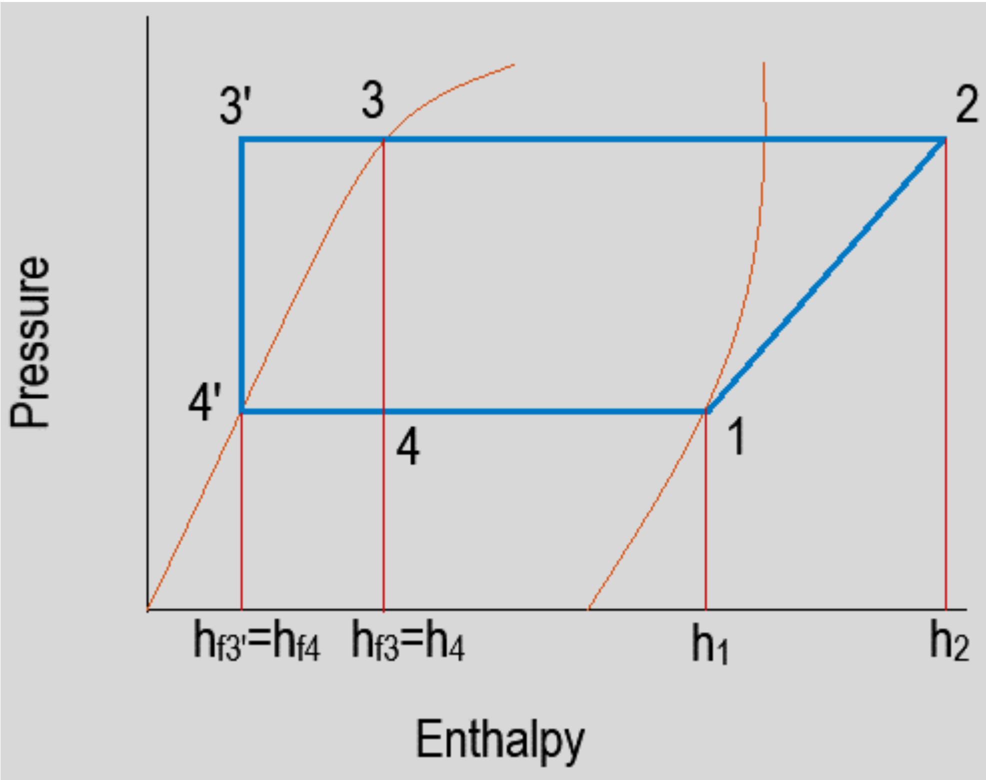


a) m_2 (h_1 âˆ' h_{f3})
b) m_2 (h_2 âˆ' h_1)
c) m_2 (h_1 âˆ' h_2)
d) m_2 (h_4 âˆ' h_1)

Answer: a
Explanation: Refrigerating effect is considered in the evaporator i.e. heat absorbed by the evaporator is called as refrigerating effect.
R.E. = m_1 (h_1 â^’ h $_{f4}$â€™)
And also, m_1 / m_2 = h_1 â^’ h_4 / h_1 â^’ h $_{f4}$â€™
Hence, R.E. = m_2 (h_1 â^’ h_{f3})

3. What is the value of C.O.P. in the VCR with flash chamber?





3'
3
2
Pressure
4'
4
1
hf3'=hf4
hf3=h4
h1
h2
Enthalpy

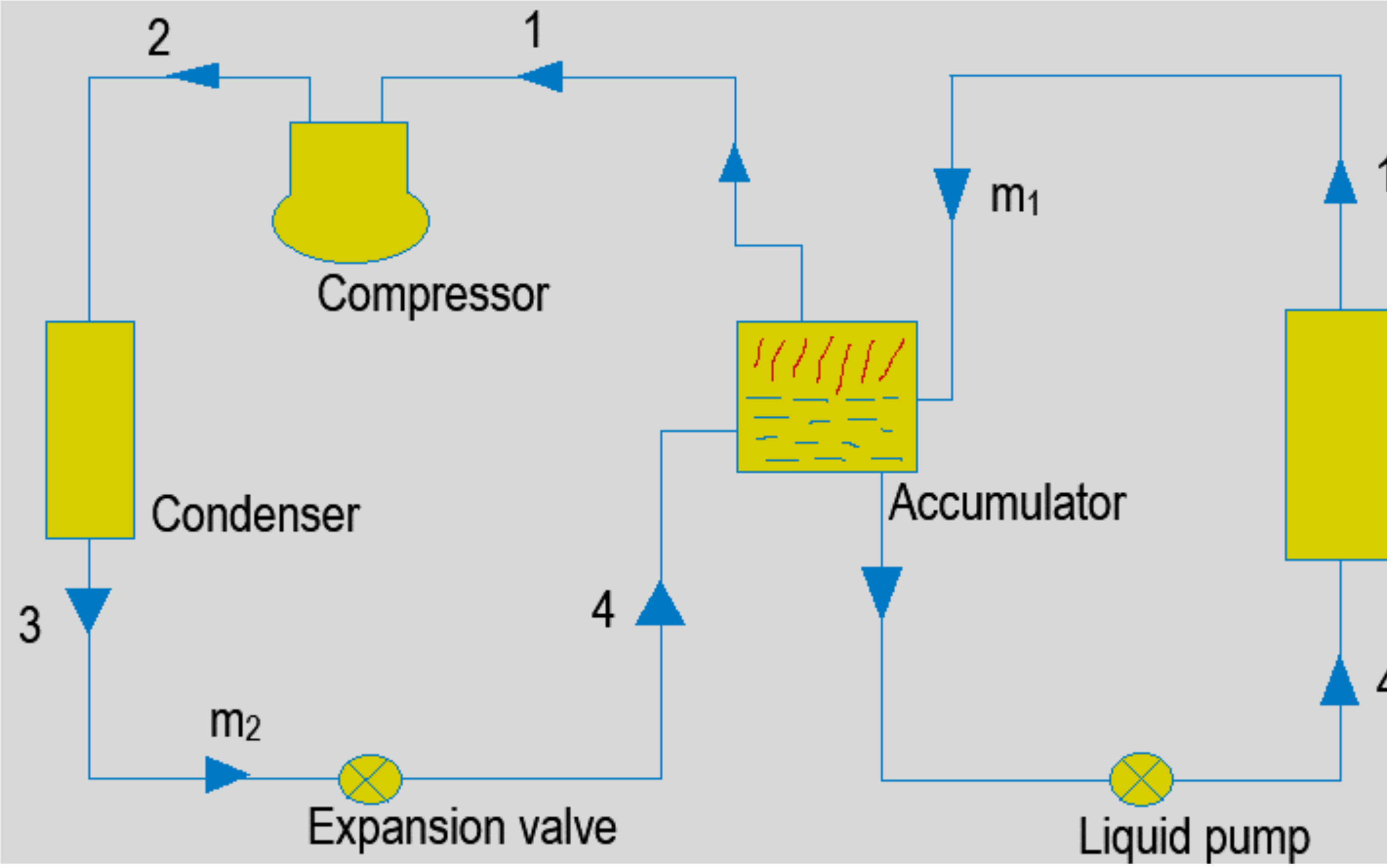
a) h_1 â€“ h_2 / h_1 â€“ h_4
b) h_1 â€“ h_{f3} / h_2 â€“ h_1
c) h_2 â€“ h_1 / h_4 â€“ h_1
d) h_1 â€“ h_{f4}â€™ / h_1 â€“ h_4

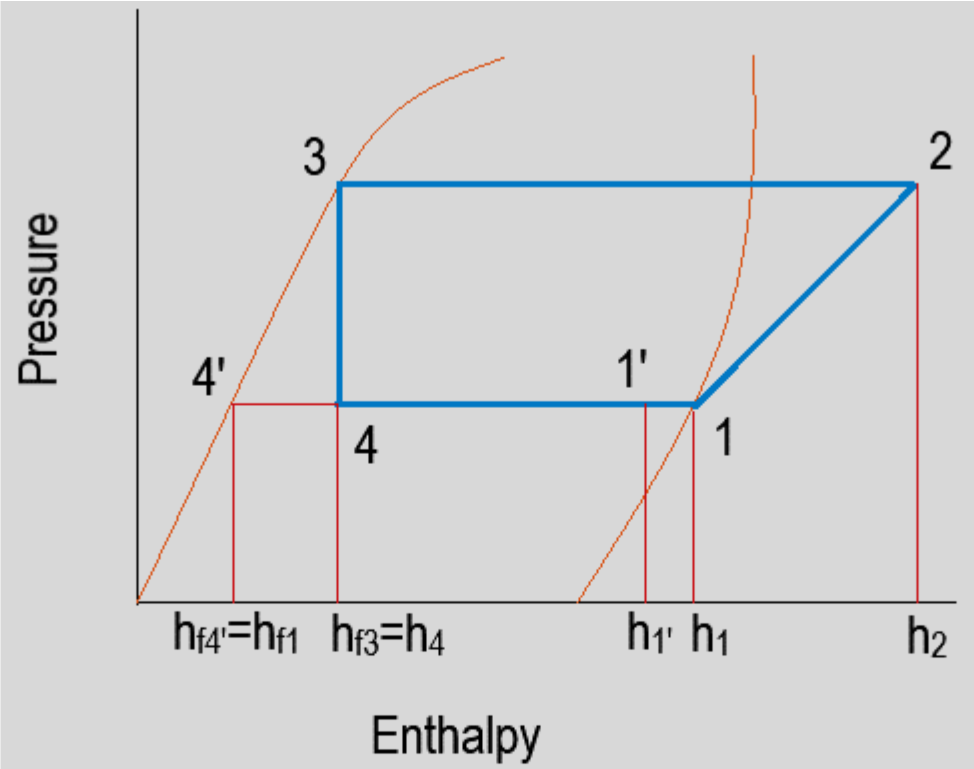
Answer: b
Explanation: C.O.P. = Refrigerating effect / Work done
Refrigerating effect in terms of m_2 = m_2 (h_1 â€“ h_{f3})
Work = m_2 (h_2 â€“ h_1)
C.O.P. = m_2 (h_1 â€“ h_{f3}) / m_2 (h_2 â€“ h_1)
C.O.P. = (h_1 â€“ h_{f3}) / (h_2 â€“ h_1)

4. What is the effect of using accumulator in the VCR system?
a) C.O.P. increases
b) C.O.P. decreases
c) Total dry compression of refrigerant occurs
d) Sub-cooling happens

Answer: c
Explanation: As C.O.P. of the VCR system containing accumulator is given by,
C.O.P. = h_1 â€“ h_{f3} / h_2 â€“ h_1
Which is same as the simple VCR cycle. The purest forms of refrigerant enter the respective system but effectively do not give enormous impact on C.O.P. So C.O.P. remains the same.
The C.O.P., R.E., and power required are the same, but it protects the liquid refrigerant from entering the compressor. Dry compression is always ensured by using accumulator or pre-cooler.

5. What is the value of C.O.P. in the VCR with a flash chamber?

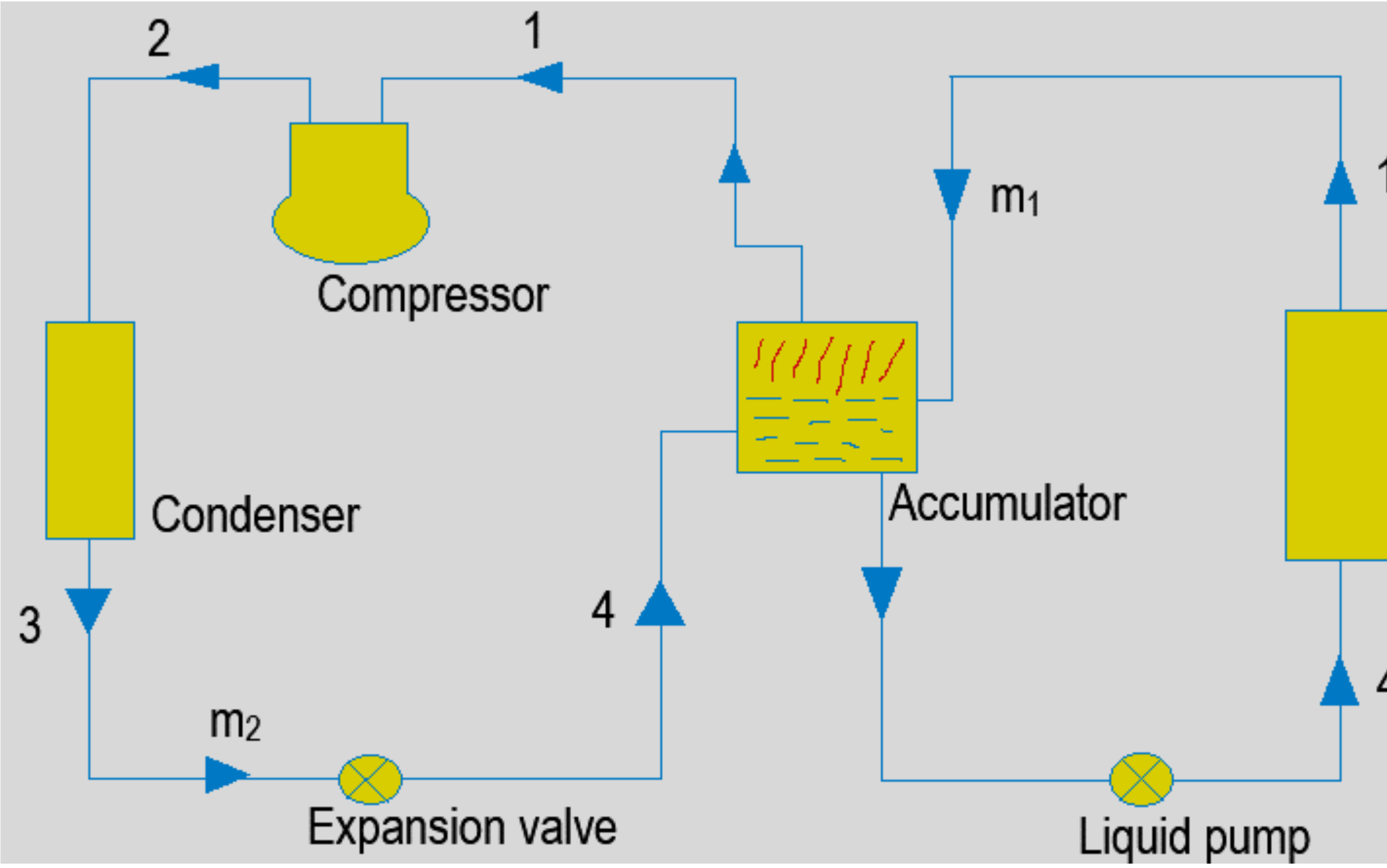


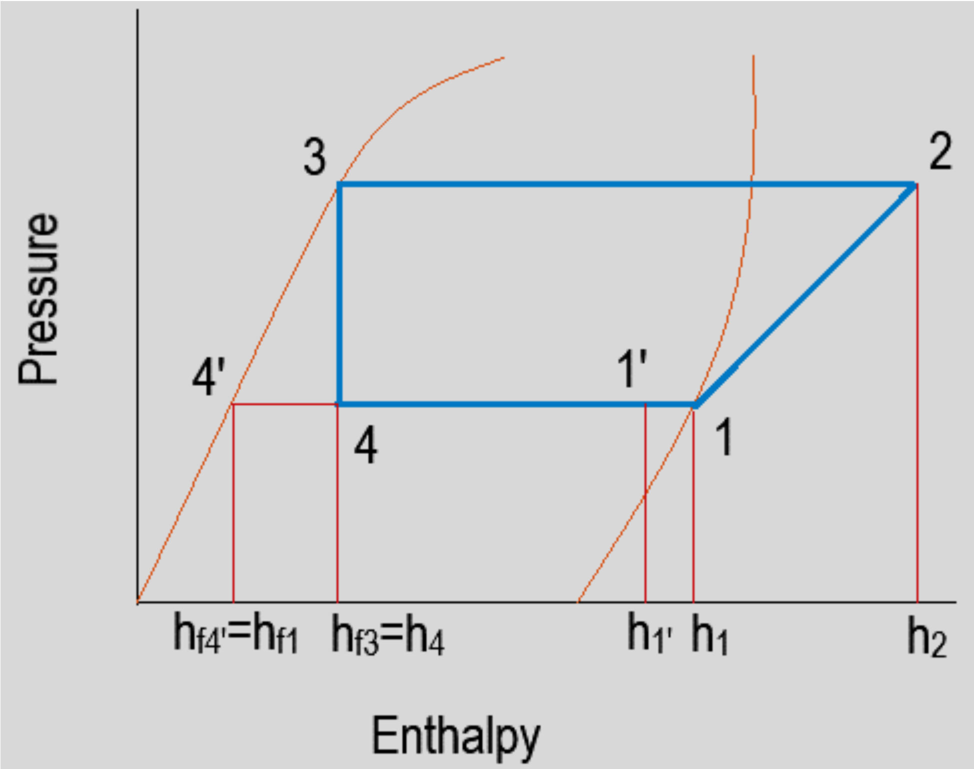


a) h_1 â€“ h_2 / h_1 â€“ h_4
b) h_1 â€“ h_{f3} / h_2 â€“ h_1
c) h_2 â€“ h_1 / h_4 â€“ h_1
d) h_1 â€“ $h_{f4â€™}$ / h_1 â€“ h_4

Answer: b
Explanation: C.O.P. = Refrigerating effect / Work done
Refrigerating effect in terms of m_2 = m_2 (h_1 â€“ h_{f3})
Work = m_2 (h_2 â€“ h_1)
C.O.P. = m_2 (h_1 â€“ h_{f3}) / m_2 (h_2 â€“ h_1)
C.O.P. = (h_1 â€“ h_{f3}) / (h_2 â€“ h_1)

6. From the following line diagram and p-h chart, what is the power required in terms of the mass of refrigerant flowing in the condenser i.e., m_2 ?

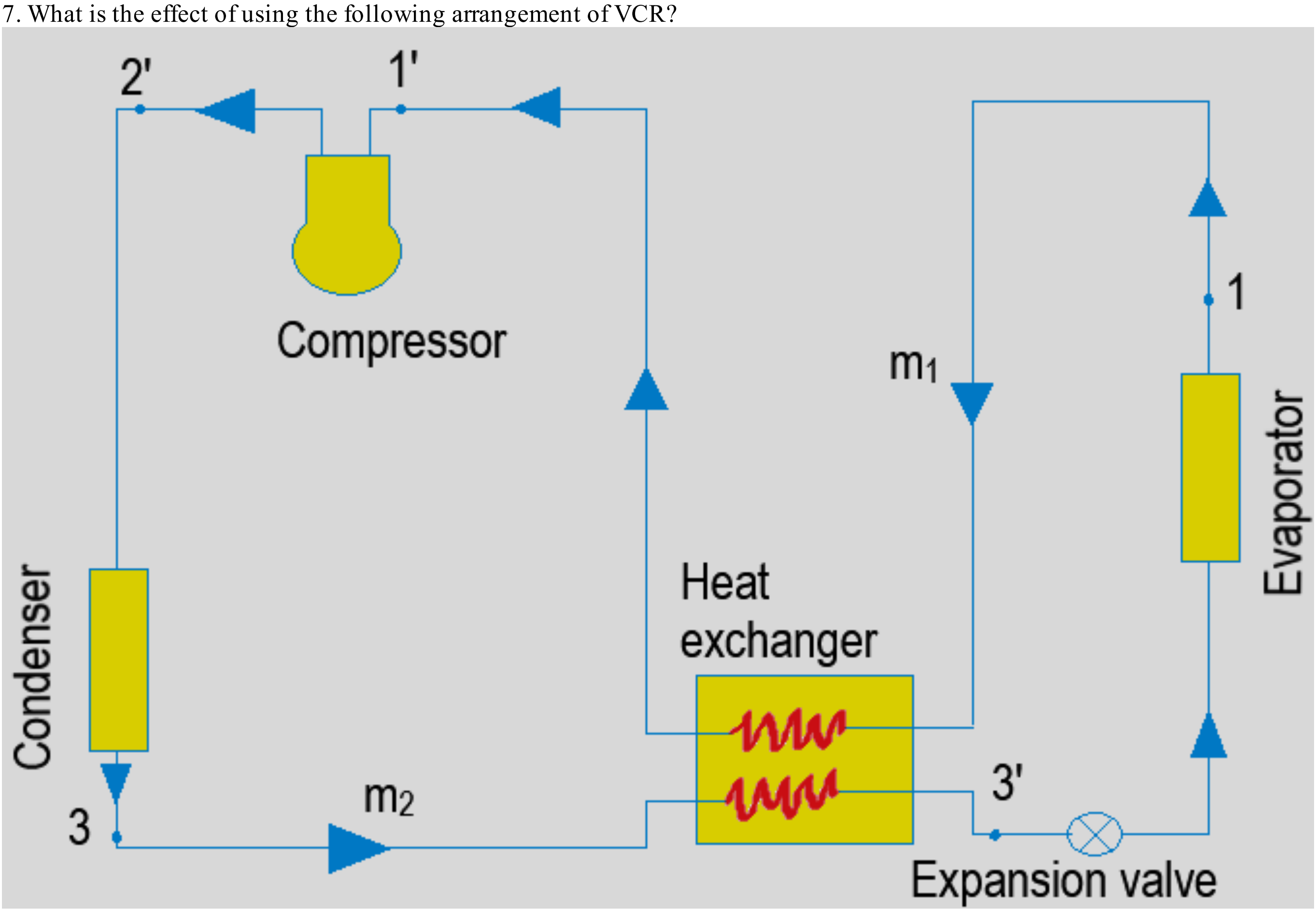




a) m_2 (h_1 â€“ h_2) / 60
b) m_2 (h_1 â€“ h_4) / 60
c) m_2 (h_2 â€“ h_1) / 60
d) m_2 ($h_{1â€™}$ â€“ $h_{f4â€™}$) / 60

Answer: c
Explanation: Work is done by the compressor. So, the enthalpies related to compressor using the diagrams are h_1 and h_2. The mass of refrigerant flowing through the compressor is m_2.
Hence, the power required is the work done per unit time.
Power i.e. P = Work / 60 (kW)
Work = m_2 (h_2 â€“ h_1)
P = m_2 (h_2 â€“ h_1) / 60.

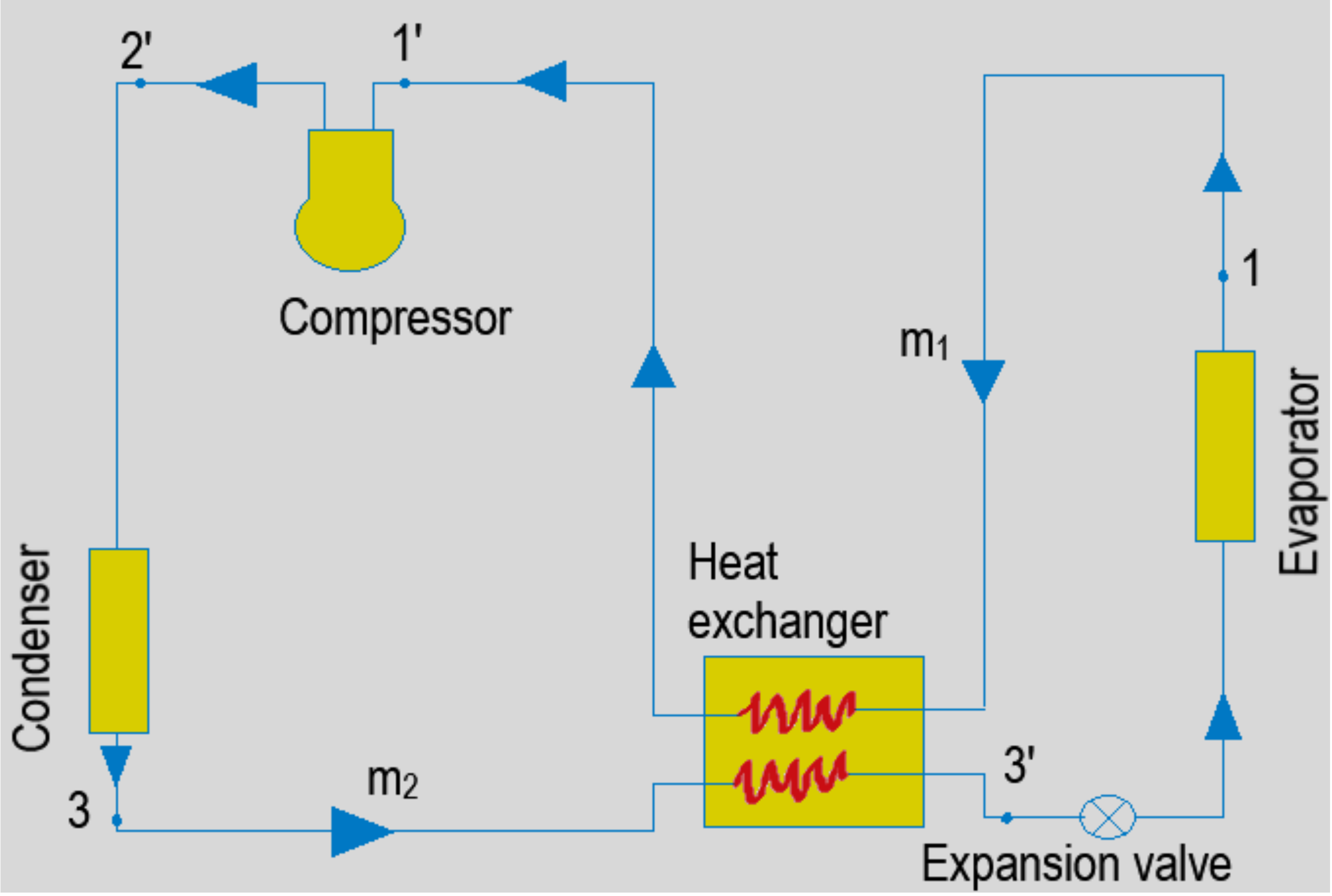
7. What is the effect of using the following arrangement of VCR?



a) C.O.P. increases
b) C.O.P. decreases
c) Total dry compression of refrigerant occurs
d) Sub-cooling does not occur

Answer: b
Explanation: Though sub-cooling is carried out in this arrangement. But the actual installations and many other losses affect widely over the sub-cooling. Sub-cooling increases the refrigeration effect and losses increase the compressor work and decreases refrigeration effect in some cases. So, C.O.P. being the ratio of refrigeration effect and work, effectively it reduces.

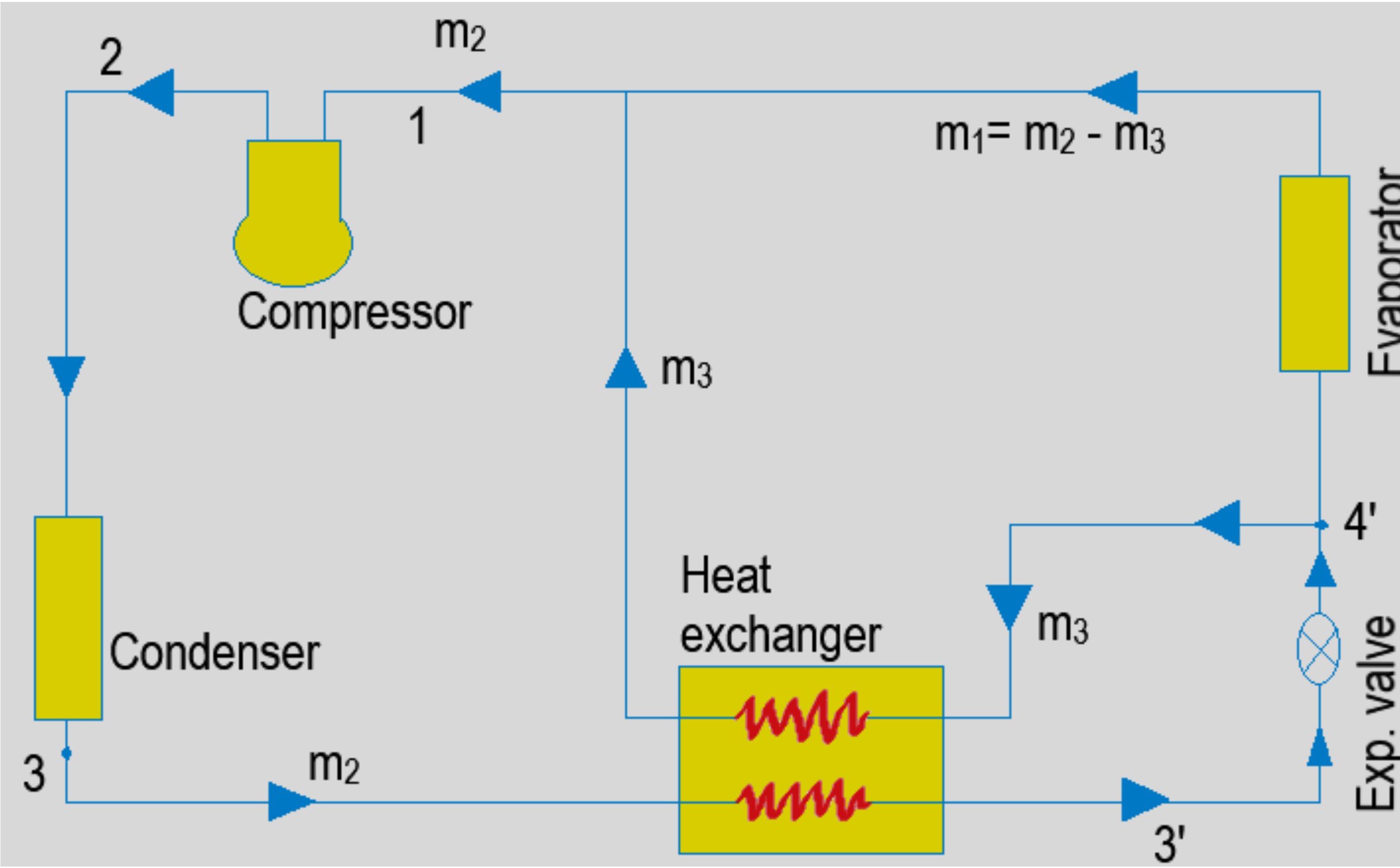
8. What is the ratio of the mass of the vapor refrigerant and mass of the liquid refrigerant i.e., m_1 / m_2 ?

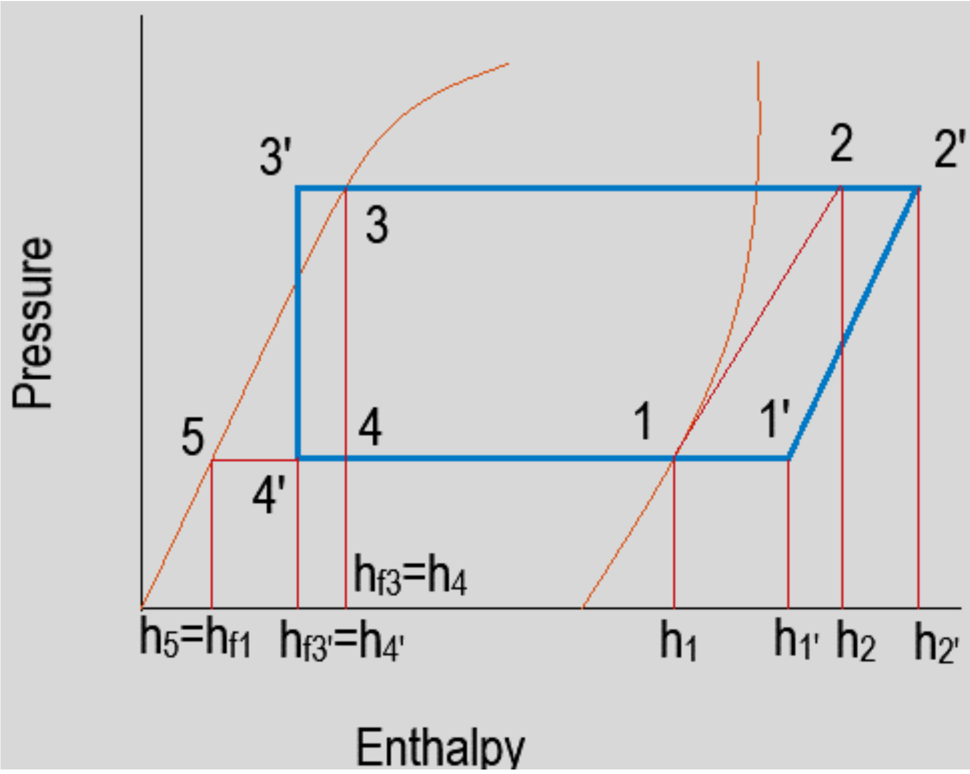


a) 1
b) h_1 â€“ h_4 / $h_{1â€™}$ â€“ $h_{f4â€™}$
c) 0
d) $h_{1â€™}$ â€“ $h_{f4â€™}$ / h_1 â€“ h_4

Answer: a
Explanation: In the case of this kind of heat exchanger, heat transfer takes place between vapor and liquid refrigerant due to the change of temperature and specific heat. As the mass flowing through condenser and evaporator is same. Due to heat transfer, mass does not get affected. Hence,
$m_1 = m_2$ or $m_1 / m_2 = 1 = m_R = 210\ Q / (h_1$ â€“ $h_{f3â€™})$ kg/min.

9. What is the value of excess power required in this arrangement of VCR if P_1 is the power required without heat exchanger and P_2 is the power required with heat exchanger?

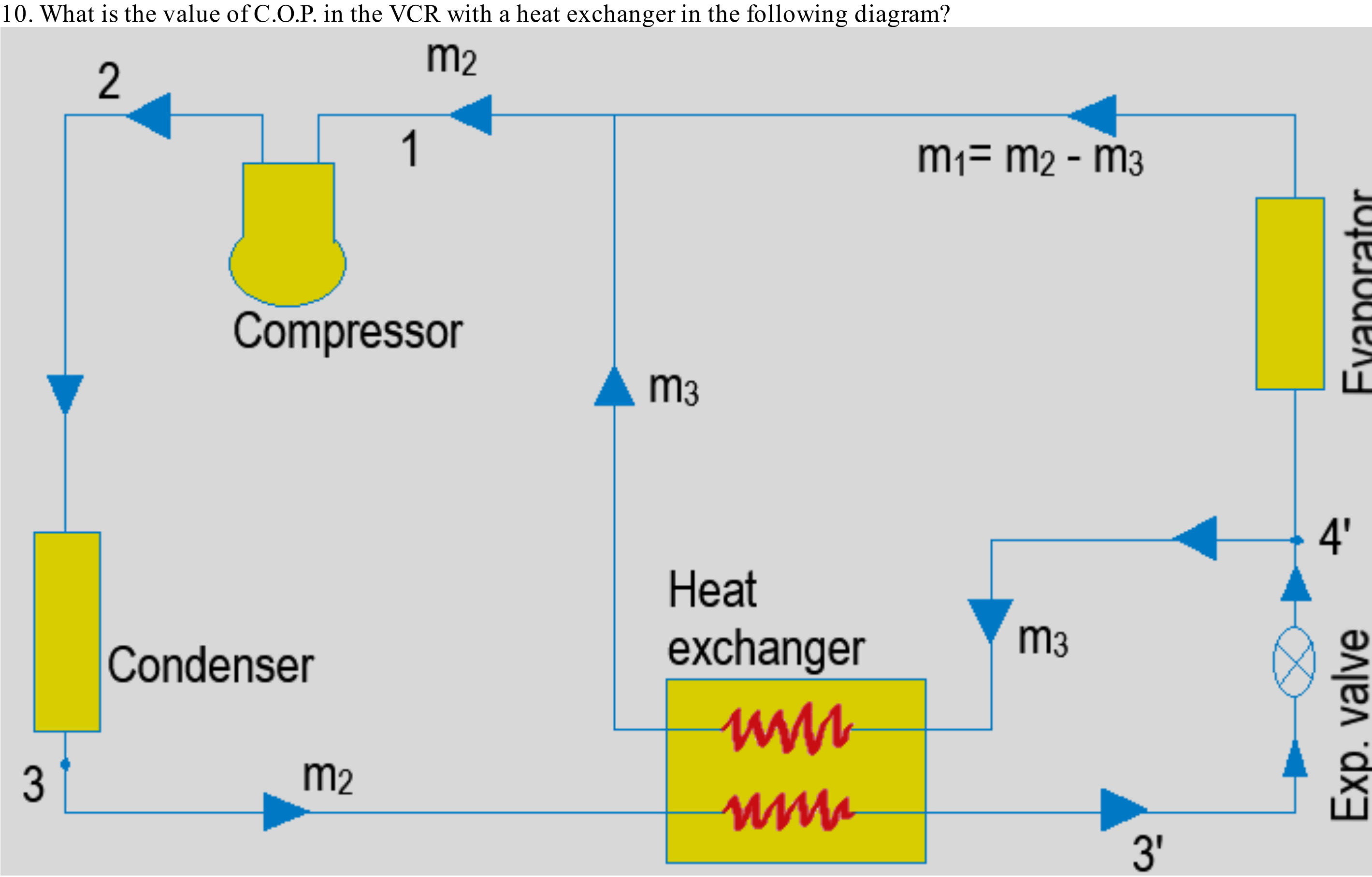


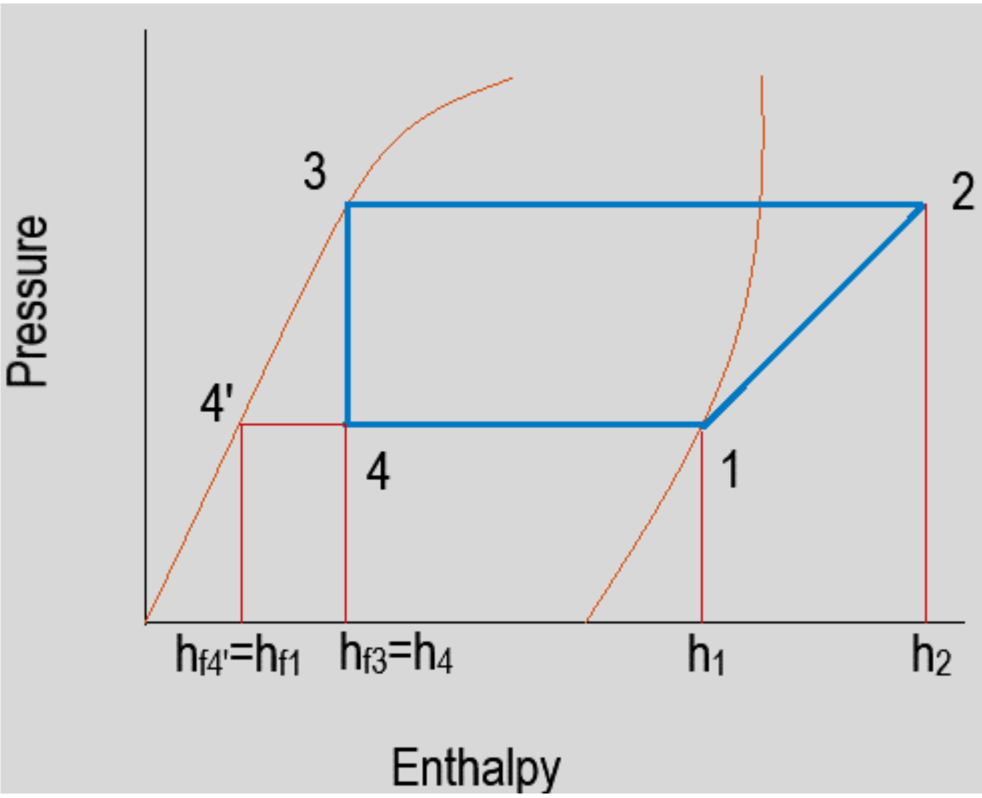


a) $P_{excess} = P_1 / P_2$
b) $P_{excess} = P_1 \times P_2$
c) $P_{excess} = P_1 + P_2$
d) $P_{excess} = P_1$ â€“ P_2

Answer: d
Explanation: Power required to drive the compressor,
P$_1$ = m$_R$ (h$_2$â€™ â€“ h$_1$â€™) / 60 = 210 Q [h$_2$â€™ â€“ h$_1$â€™ / h$_1$ â€“ h$_{f3}$â€™] / 60
Power required to drive the compressor without heat exchanger,
P$_2$ = m$_R$ (h$_2$ â€“ h$_1$) / 60 = 210 Q [h$_2$ â€“ h$_1$ / h$_1$ â€“ h$_{f3}$] / 60
P$_{excess}$ = P$_1$ â€“ P$_2$
= 210 [(h$_2$â€™ â€“ h$_1$â€™ / h$_1$ â€“ h$_{f3}$â€™) â€“ (h$_2$ â€“ h$_1$ / h$_1$ â€“ h$_{f3}$)] / 60 kW.

10. What is the value of C.O.P. in the VCR with a heat exchanger in the following diagram?

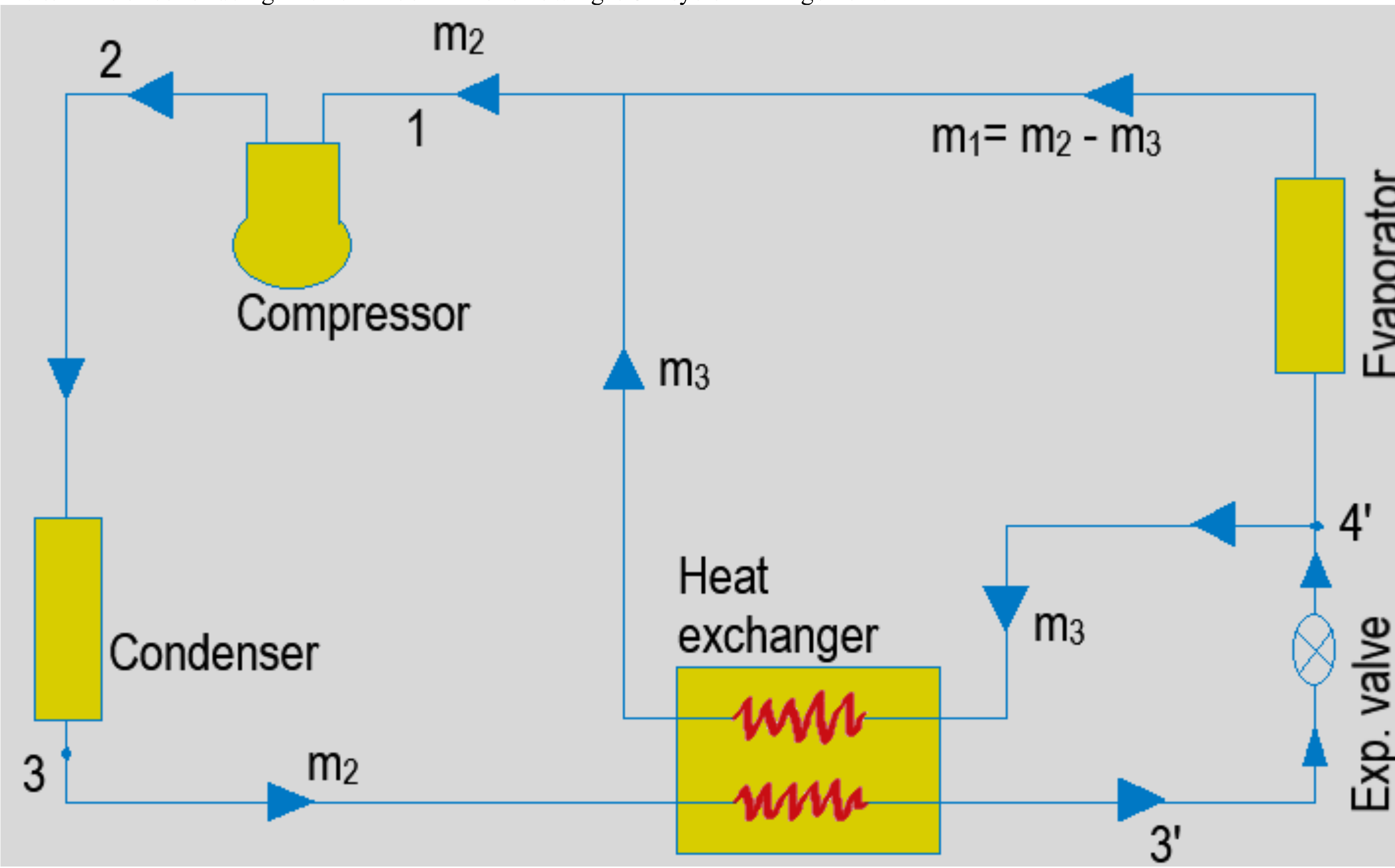


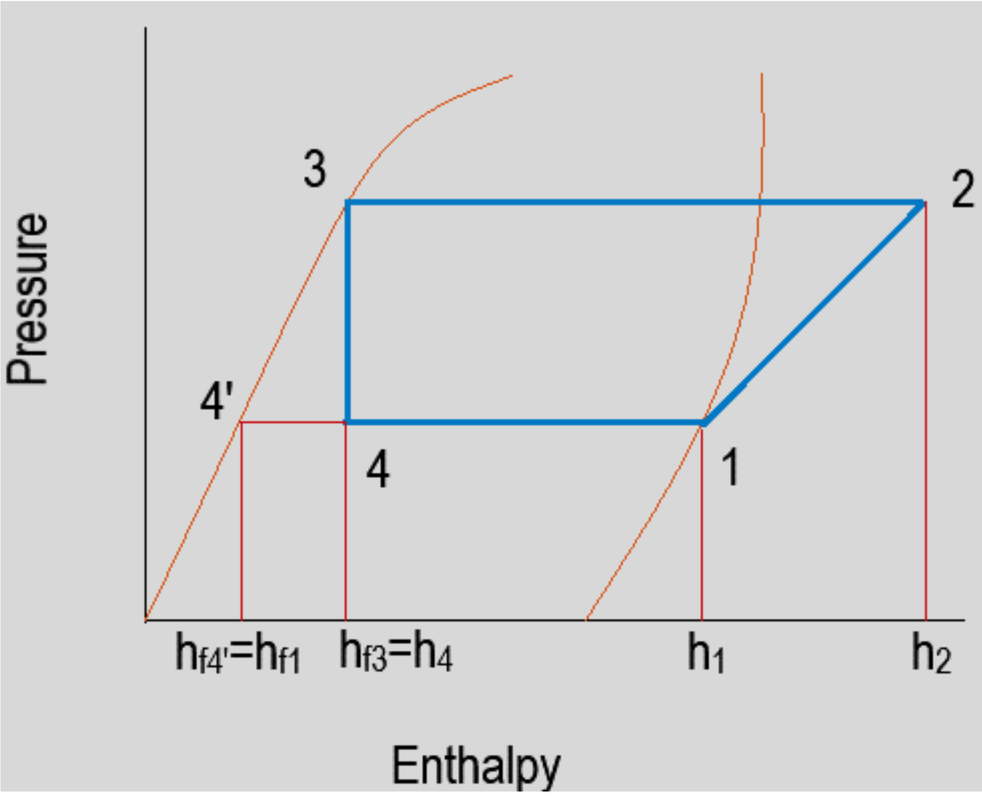

Pressure
3
2
4'
4
1
hf4'=hf1
hf3=h4
h1
h2
Enthalpy

a) h_1 â€“ h_2 / h_1 â€“ h_4
b) h_1 â€“ h_{f3} / h_2 â€“ h_1
c) h_2 â€“ h_1 / h_4 â€“ h_1
d) h_1 â€“ $h_{\text{f4â€™}}$ / h_1 â€“ h_4

Answer: b
Explanation: C.O.P. = Refrigerating effect / Work done
Refrigerating effect in terms of m_2 = m_2 (h_1 â€“ h_{f3})
Work = m_2 (h_2 â€“ h_1)
C.O.P. = m_2 (h_1 â€“ h_{f3}) / m_2 (h_2 â€“ h_1)
C.O.P. = (h_1 â€“ h_{f3}) / (h_2 â€“ h_1).

11. What is effect of using flash chamber in the following VCR system arrangement?





a) C.O.P. remains the same
b) C.O.P. decreases
c) C.O.P. increases
d) Subcooling affects significantly on C.O.P.

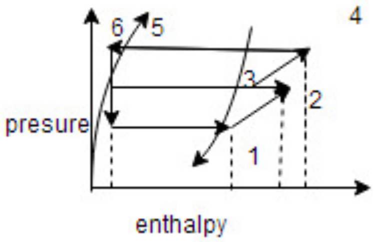
Answer: a
Explanation: As C.O.P. of the VCR system containing flash chamber is given by,
C.O.P. = h_1 â€“ h_{f3} / h_2 â€“ h_1
Which is same as the simple VCR cycle. The purest forms of refrigerant enter the respective system but effectively do not give enormous impact on C.O.P. So C.O.P. remains the same.
The subcooling of liquid refrigerant is of no advantage. The above method of subcooling is thermodynamically the same as the simple saturation cycle.

12. Mass of refrigerant required in the heat exchanger is exactly equal to the mass of flash that would form in a simple saturation cycle.
a) True
b) False

Answer: a
Explanation: When the liquid refrigerant at high pressure from the condenser passes through the expansion valve, some part of that liquid refrigerant evaporates. This partial evaporation of the liquid refrigerant is known as the flash. Heat exchanger does the same type of work. It exchanges the heat using the liquid and vapor refrigerant where some of the liquid refrigerants partially evaporate.

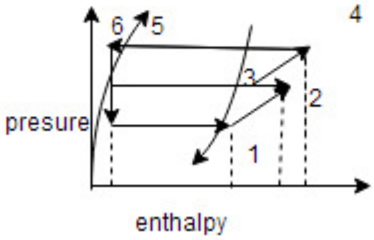
This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œTwo/Multi Stage Compression with Water Intercooling and Liquid Subcooling â€“ 1â€�.

1. What type of compound vapor compression is the following diagram of?



a) Two stage vapor compression with liquid intercooler
b) Three stage vapor compression with water intercooler and liquid subcooler
c) Two stage vapor compression with flash intercooler
d) Two stage vapor compression with water intercooler and liquid subcooler

Answer: d
Explanation:



The diagram itself shows that it consists of two stage vapor compression with liquid sub cooler as shown in the process (5 â€“ 6) and water intercooler from the process (1 â€“ 2) and (3 â€“ 4). For three stages there would have been three such processes.

2. A compound vapor compression with a liquid subcooler and a liquid intercooler system is used to take 10 TR of refrigeration load (Q). The power required for the refrigerating system P is 557.7 W. What is its COP?
a) 6.87
b) 4.75
c) 3.77
d) 5.86

Answer: c
Explanation: COP = \(\frac{210Ã—Q}{W}\)
COP = \(\frac{210Ã—10}{557}\)
= 3.77.

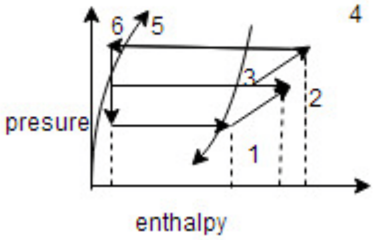
3. The water intercooling reduces the work to be done in low pressure compression.
a) True
b) False

Answer: b
Explanation: The water intercooling reduces the work to be done in high pressure compression. It also reduces the specific volume of refrigerant which requires a compressor of small size.

4. The complete desuperheating of the vapor refrigerant is not possible in case of water intercooling.
a) True
b) False

Answer: a
Explanation: The complete desuperheating of the vapor refrigerant is not possible in case of water intercooling. It is due to the fact that the temperature of the cooling water used in the water intercooler is not available sufficiently low so as to desuperheat the vapor completely.

5. Which one of the processes is the liquid subcooling process?



a) Process (1 â€“ 2)
b) Process (2 â€“ 3)
c) Process (4 â€“ 5)
d) Process (5 â€“ 6)

Answer: d
Explanation: The temperature of saturated liquid refrigerant s further reduced by passing it through a liquid sub cooler as shown in the process (5 â€“ 6).

6. What is the value of the load on the evaporator in terms of TR if the power required to drive the system is 25 kW and C.O.P. is 4?
a) 30.75
b) 28.25
c) 28.15
d) 28.57

Answer: d
Explanation: Given: P = 25 kW
C.O.P. = 4
As, Power = Work / 60
Work = Power x 60
= 25 x 60
= 1500 kJ/min

C.O.P. = R.E. / Work
R.E. = C.O.P. x Work
= 4 x 1500
= 6000 kJ/min
R.E. = 210 Q
Q = R.E. / 210
= 6000 / 210
= 28.57 TR.

7. If the compound vapour compression system is working under the load on the evaporator of 15 TR, the enthalpies corresponding to the evaporator are 1400 and 400 kJ/kg respectively. What is the value of the mass flow rate through the evaporator?
a) 3.75
b) 3.25
c) 3.15
d) 3.45

Answer: c
Explanation: Given: R.E. = 15 TR = 15 x 210 = 3150 kJ/min
h_1 = 1400 kJ/kg and h_7 = 400 kJ/kg
As, m = 210 Q / (h_1 â€“ h_7)
= 3150 / (1400 â€“ 400)
= 3150 / 1000 = 3.15.

This set of Refrigeration Multiple Choice Questions & Answers focuses on â€œTwo/Multi Stage Compression with Liquid Intercooling â€“ 2â€�.

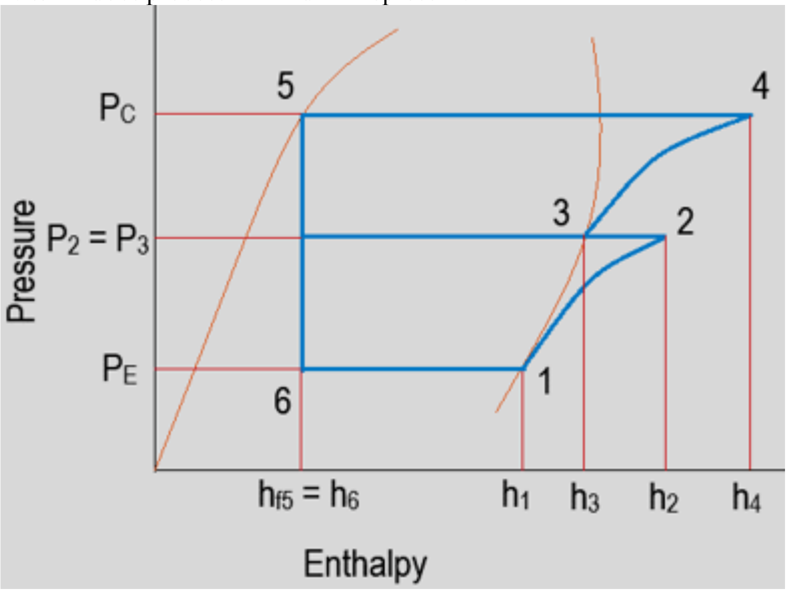
1. Why multi-stage or compound VCR with intercooler is used?
a) To improve C.O.P.
b) To decrease the refrigeration effect
c) To increase work
d) To increase leakage loss

Answer: a
Explanation: By expanding the refrigerant very close to the saturated liquid state refrigeration effect can be improved. And if the refrigerant is compressed very near to the saturated vapor line by using compression in more stages with intermediate intercooling, work can be reduced. Increase in refrigeration effect and decrease in work leads to improve the C.O.P. of the system.

2. What is the purpose of using intercooler?
a) To increase the cost of the compressor
b) To reduce the volumetric efficiency
c) To re-heat superheated refrigerant
d) To cool the superheated refrigerant

Answer: d
Explanation: Intercooler is used to cool the superheated refrigerant till the saturated vapor line. The superheated refrigerant leaving the first compressor is cooled by suitable method before entering the second compressor. This type of cooling is known as intercooling.

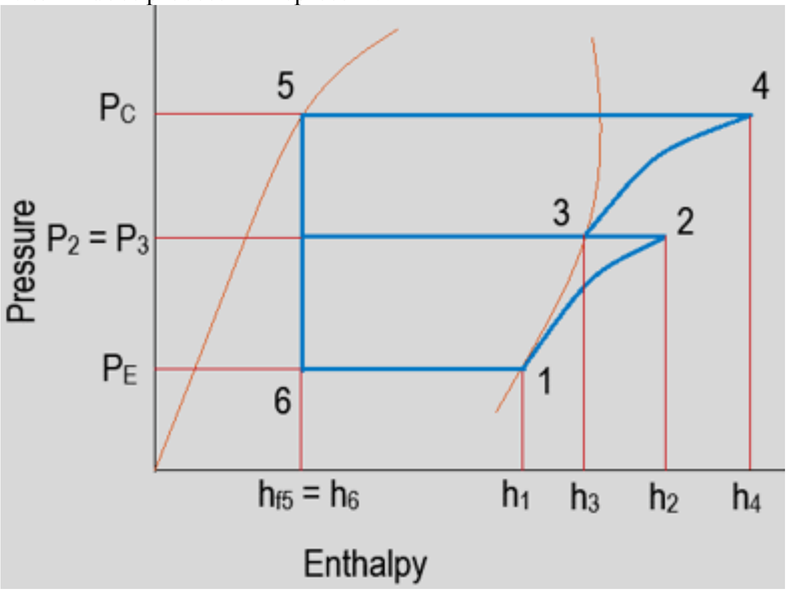
3. What does process 1-2 and 3-4 represent?



a) Evaporation
b) Compression
c) Condensation
d) Expansion

Answer: b
Explanation: Process 1-2 and 3-4 represent compression. This type of compression is isentropic compression, which is carried out in two stages. The first compression is carried out in low-pressure compressor and then compressed in the high-pressure compressor.

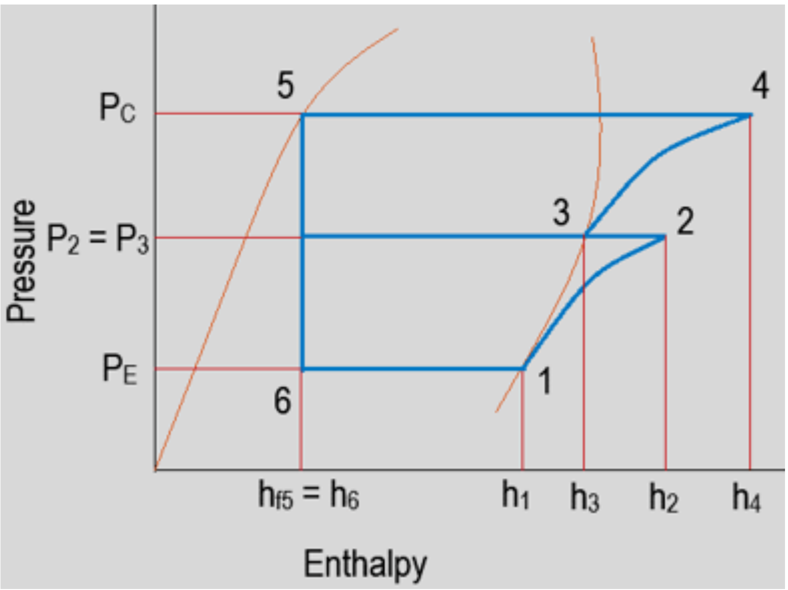
4. What does process 2-3 represent?



a) Evaporation
b) Compression
c) Condensation
d) Intercooling

Answer: d
Explanation: Process 2-3 represent intercooling or de-superheating. Intercooling is carried out to bring the refrigerant to the saturated vapor line before the second stage of compression. Intercooling results in effective compression in the high-pressure compressor resulting in the reduction of the overall work done.

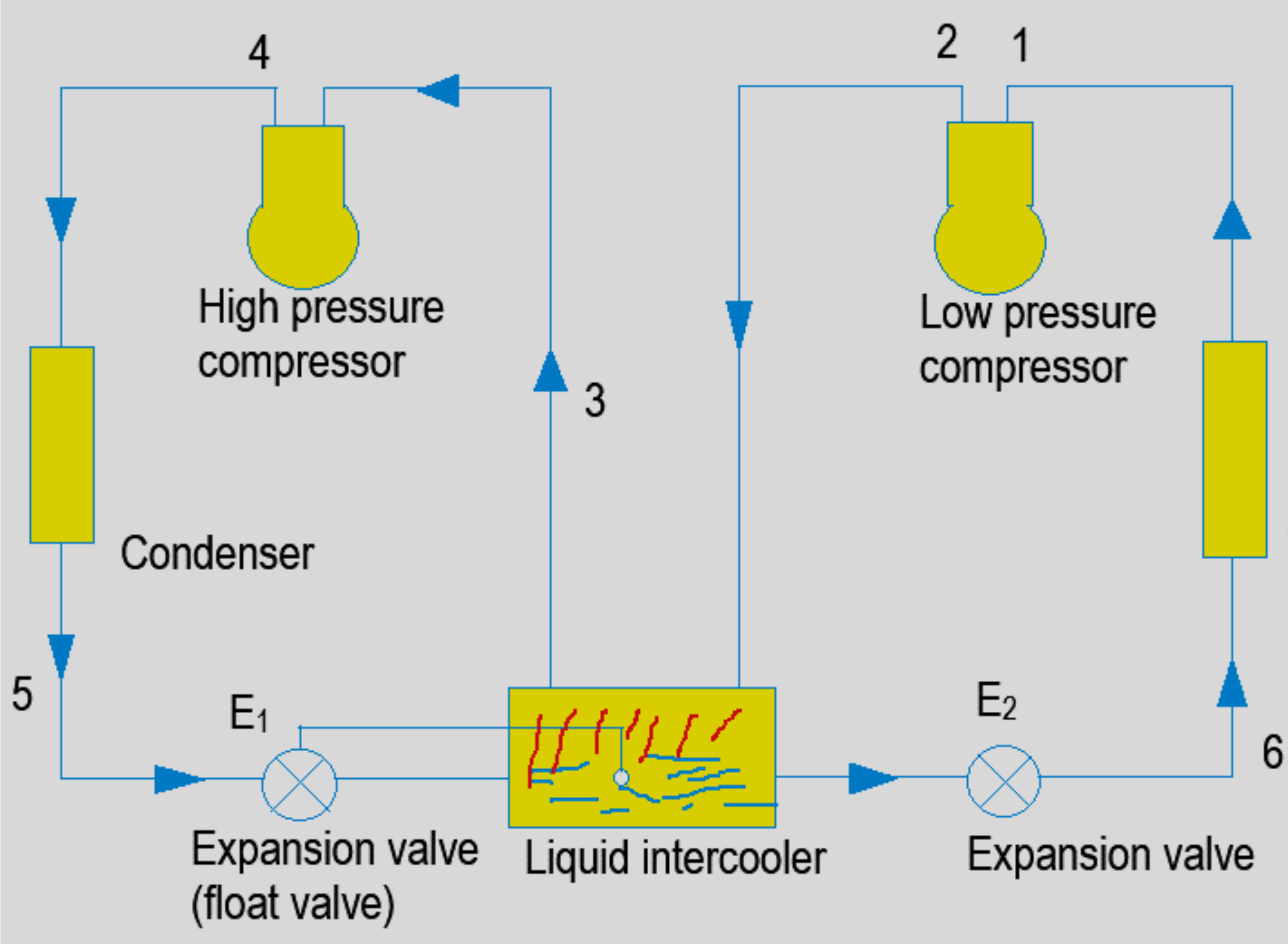
5. What do P_C and P_E represent?



a) Evaporator and expansion pressure
b) Compression and expansion pressure
c) Condenser and evaporator pressure
d) Intercooling pressure

Answer: c
Explanation: P_C is for condenser pressure. The pressure at which latent heat is rejected from the refrigerant and converting vapor form to liquid form. P_E is for evaporator pressure. The pressure at which latent heat of vaporization is absorbed from the medium and phase change from liquid to vapor is carried out. Attaining and maintaining these pressures is essential for the smooth operation of the cycle.

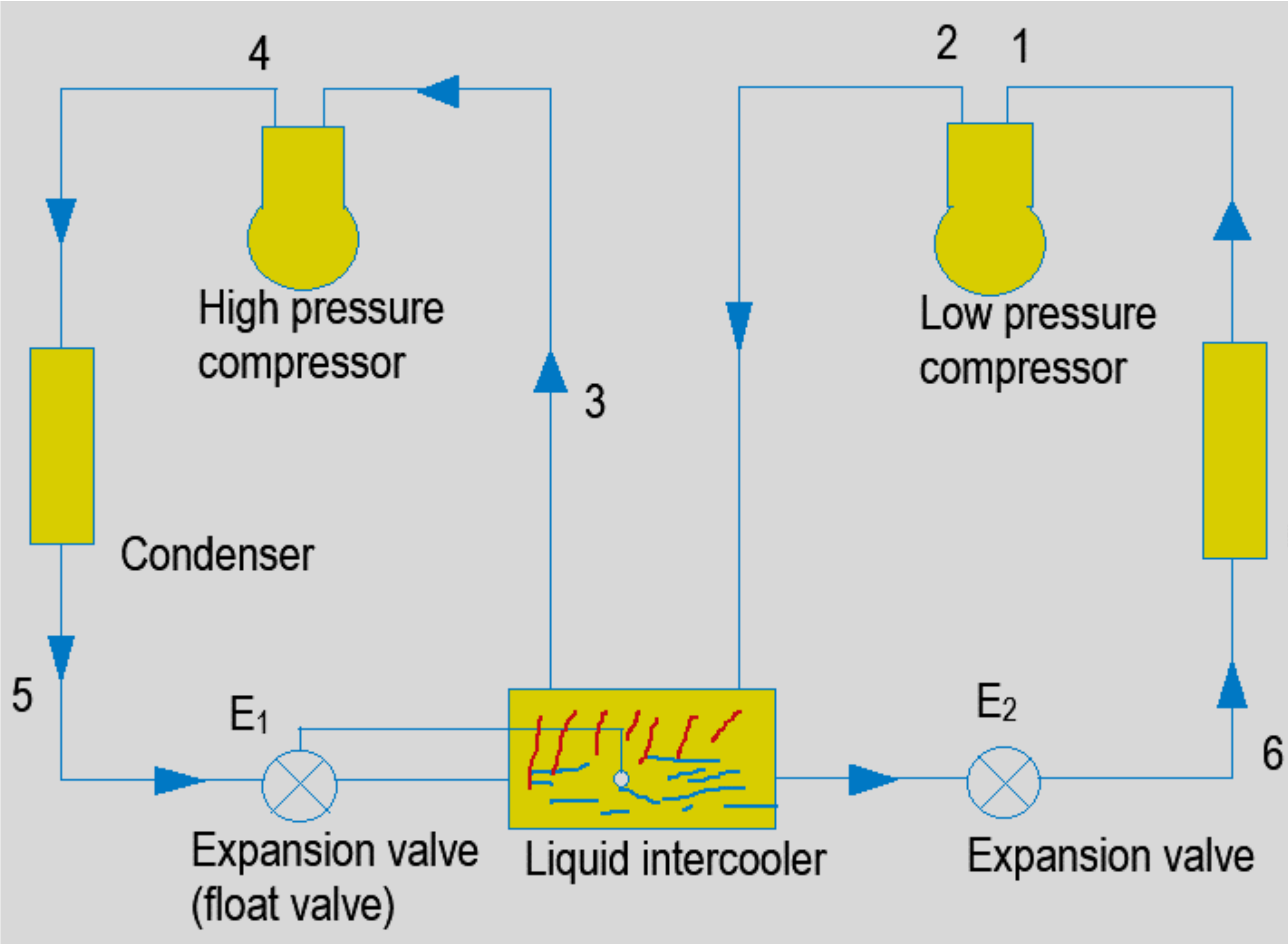
6. What is the relation between m_1, m_2, and m_3?



If m_1 = mass of refrigerant passing through the evaporator
m_2 = mass of refrigerant passing through the condenser
m_3 = mass of liquid evaporated in the intercooler
a) $m_3 = m_1 + m_2$
b) $m_3 = m_1$ â€“ m_2
c) $m_3 = m_2$ â€“ m_1
d) $m_3 = m_1 / m_2$

Answer: c
Explanation: The high-pressure compressor will compress the mass of refrigerant discharging from the low-pressure compressor (m_1) and the mass of liquid evaporated in the liquid intercooler during intercooling or de-superheating of superheated vapor refrigerant from the low-pressure compressor. So, the mass of liquid evaporated in the intercooler is equal to the difference between the mass of refrigerant passing through the condenser and the mass of refrigerant passing through the evaporator, from the diagram.
Hence, $m_3 = m_2$ â€“ m_1.

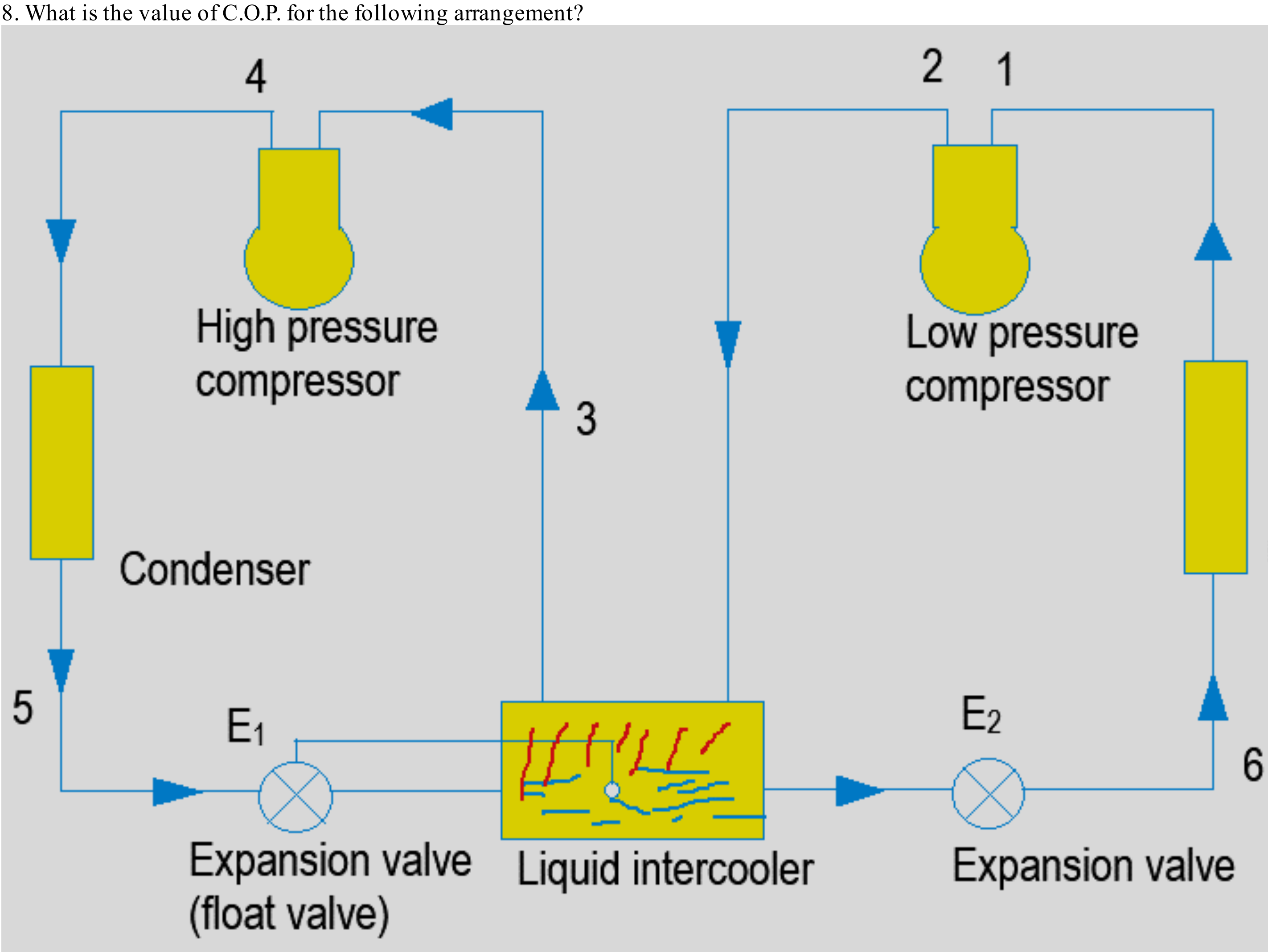
7. What is the ratio of the mass of refrigerant flowing through condenser and mass of refrigerant flowing through the evaporator, i.e., m_2 / m_1 ?

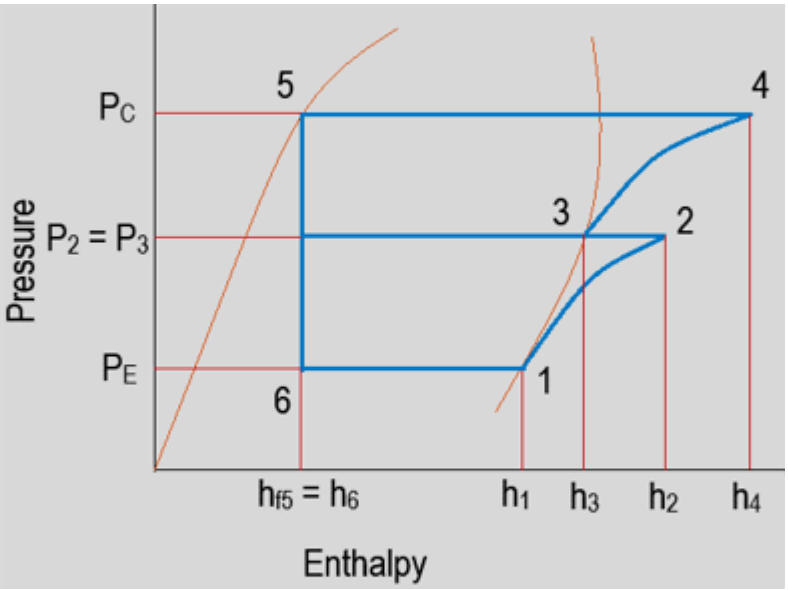

4
2
1
High pressure compressor
Low pressure compressor
3
Condenser
5
E_1
E_2
6
Expansion valve (float valve)
Liquid intercooler
Expansion valve

If m_1 = mass of refrigerant passing through the evaporator
m_2 = mass of refrigerant passing through the condenser
a) h_2 â€“ h_6 / h_3 â€“ h_{f5}
b) h_1 â€“ h_6 / h_1 â€“ h_{f5}
c) h_2 â€“ h_3 / h_1 â€“ h_{f5}
d) h_2 â€“ h_4 / h_1 â€“ h_{f5}

Answer: a
Explanation: As the mass flowing through the respective systems is given. An intercooler is an isolated system. So, by considering the thermal equilibrium for the liquid intercooler we get,
The heat taken by the liquid intercooler = Heat given by the liquid intercooler
$m_2 h_{f5} + m_1 h_2 = m_1 h_6 + m_2 h_3$
m_2 (h_3 â€“ h_{f5}) = m_1 (h_2 â€“ h_6)
m_2 / m_1 = h_2 â€“ h_6 / h_3 â€“ h_{f5} .

8. What is the value of C.O.P. for the following arrangement?





Pressure
P_C
$P_2 = P_3$
P_E
5
4
3
2
1
6
$h_{f5} = h_6$
h_1
h_3
h_2
h_4
Enthalpy

a) $m_1 (h_1$ â€“ $h_{f5}) / m_1 (h_2$ â€“ $h_1)$ â€“ $m_2 (h_4$ â€“ $h_3)$
b) $m_1 (h_1$ â€“ $h_{f5}) / m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3)$
c) $m_1 (h_1$ â€“ $h_{f5}) / m_1 (h_2$ â€“ $h_1)$
d) $m_1 (h_1$ â€“ $h_{f5}) / m_2 (h_4$ â€“ $h_3)$

Answer: b
Explanation: C.O.P. = Refrigeration effect / work
Hence, by taking the help of above diagrams,
R.E. = Heat absorbed in the evaporator
= mass flowing through the evaporator x enthalpy change
= $m_1 (h_1$ â€“ $h_{f5})$ as, $h_{f5} = h_6$
Work = Work done by low-pressure compressor + Work done by high-pressure compressor
= mass of refrigerant flowing through the low-pressure compressor x enthalpy change + mass of refrigerant flowing through the high-pressure compressor x enthalpy change
Work = $m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3)$
Hence, C.O.P. = $m_1 (h_1$ â€“ $h_{f5}) / m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3)$.

9. Why is such a type of arrangement used in ammonia plants?
a) High latent heat of vaporization
b) Low latent heat of vaporization
c) Medium latent heat of vaporization
d) High toxicity

Answer: a
Explanation: In the case of ammonia, total power requirement will decrease. Because the mass of liquid evaporated during intercooling is extremely small due to the high latent heat of vaporization. The constant entropy lines of ammonia become very flat in the superheat region. Thus, this type of arrangement is used in ammonia plants due to less power requirement.

This set of Refrigeration Question Bank focuses on â€œTwo/Multi Stage Compression with Water Intercooling and Liquid Subcooling â€“ 2â€�.

1. Why multi-stage or compound VCR with water intercooler and liquid sub-cooler is used?
a) To improve C.O.P.
b) To decrease the refrigeration effect
c) To increase work
d) To increase leakage loss

Answer: a
Explanation: By de-superheating or intercooling the refrigerant before the second stage compression but not till the saturated vapor line, can decrease the total work required. By using the liquid sub-cooler, subcooling is done, and an increase in the refrigeration effect is achieved. So, the increase in R.E. and decrease in work improves the C.O.P. of the system.

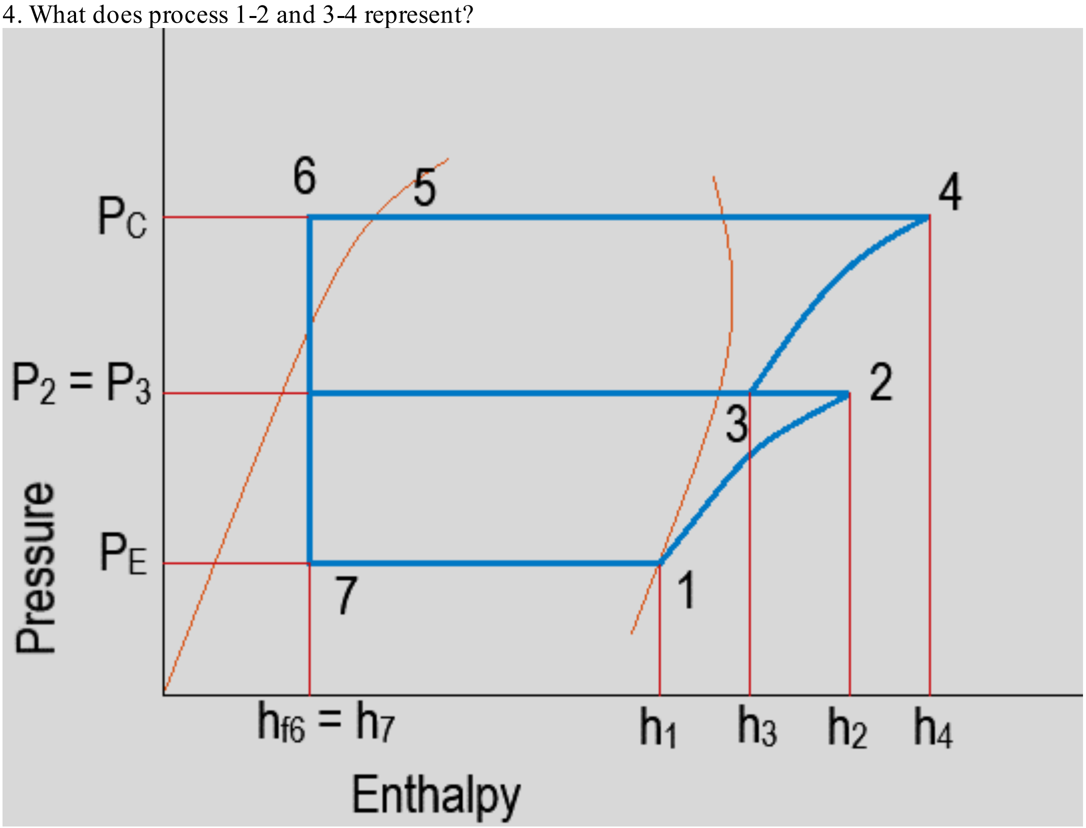
2. What is the purpose of using intercooler?
a) To increase the cost of the compressor
b) To reduce the volumetric efficiency
c) To re-heat superheated refrigerant
d) To cool the superheated refrigerant

Answer: d
Explanation: Intercooler is used to cool the superheated refrigerant by some amount but in this case, not till the saturated vapour line. The superheated refrigerant leaving the first compressor is cooled by suitable method before entering the second compressor. This type of cooling is known as intercooling.

3. What is the purpose of using liquid sub-cooler?
a) To increase the cost of compressor
b) To reduce volumetric efficiency
c) To re-heat superheated refrigerant
d) To increase the refrigeration effect

Answer: d
Explanation: Liquid sub-cooler is used to sub-cool the liquid refrigerant coming from the condenser beyond the saturated liquid line. Sub-cooling results in an increase in refrigeration effect and thus increasing the C.O.P.

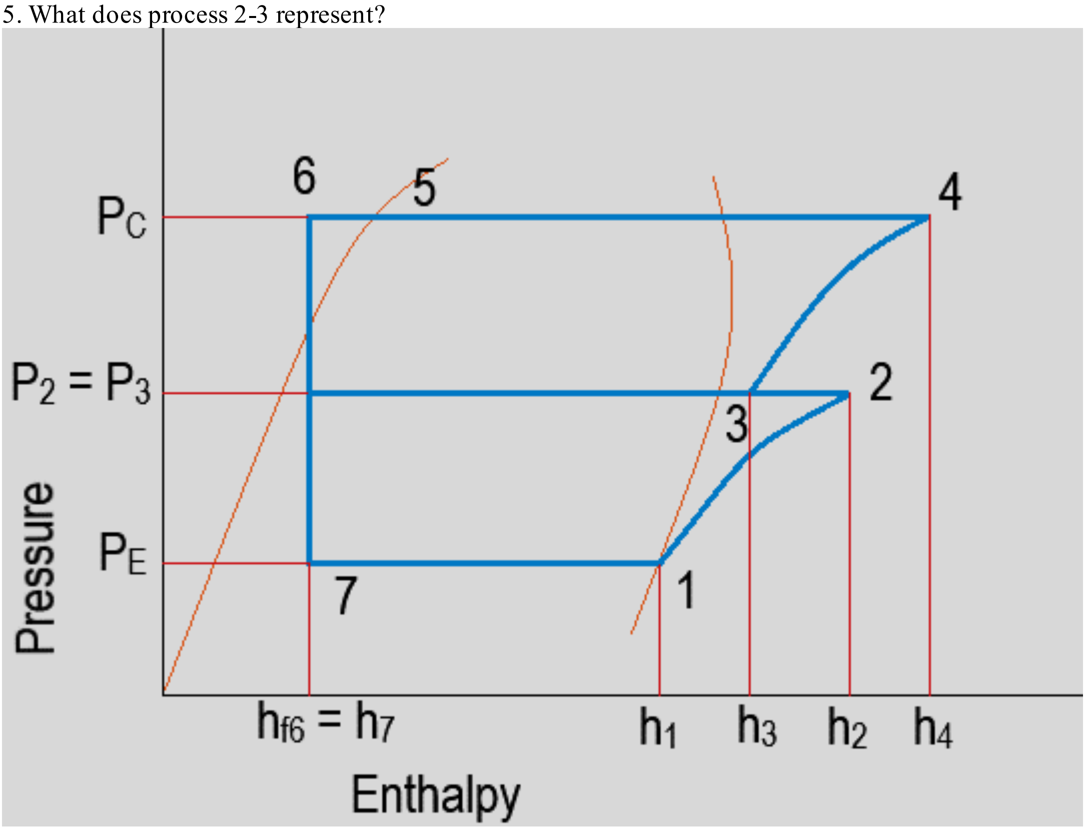
4. What does process 1-2 and 3-4 represent?



a) Evaporation
b) Compression
c) Condensation
d) Expansion

Answer: b
Explanation: Process 1-2 and 3-4 represent compression. This type of compression is isentropic compression, which is carried out in two stages. The first compression is carried out in low-pressure compressor and then compressed in the high-pressure compressor.

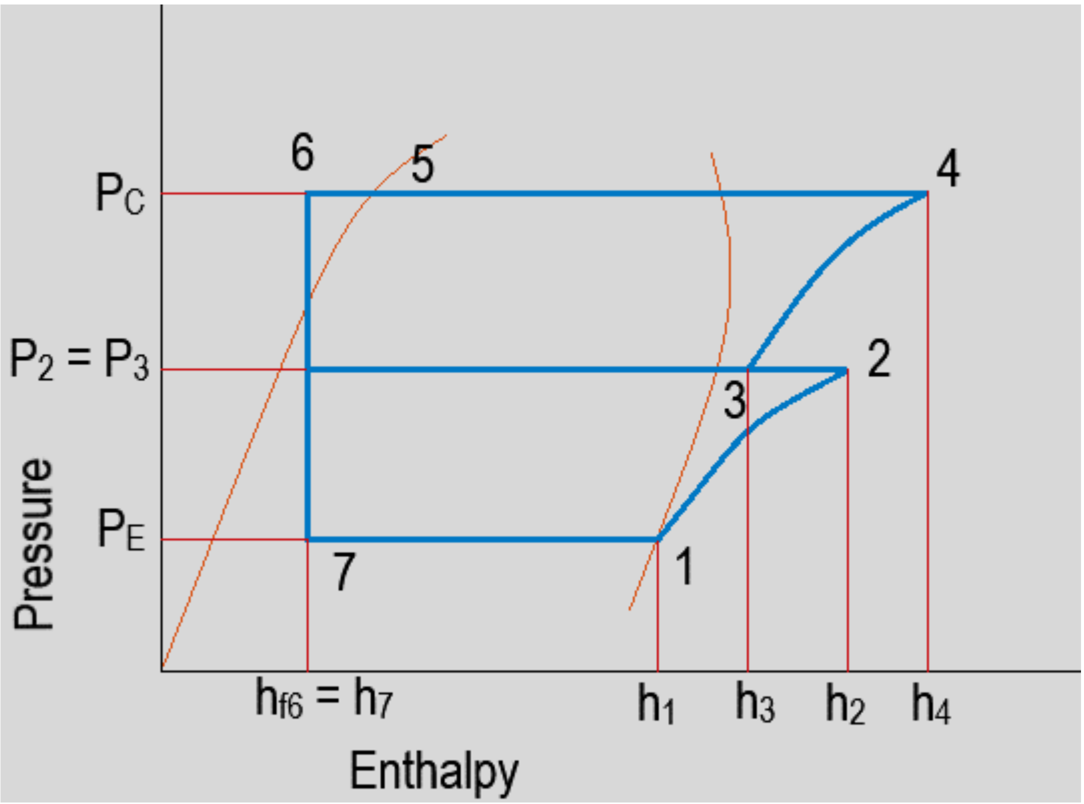
5. What does process 2-3 represent?



a) Evaporation
b) Compression
c) Intercooling
d) Condensation

Answer: d
Explanation: Process 2-3 represent intercooling or de-superheating. Intercooling is carried out to some extent but not till the saturated vapour line before the second stage of compression. Intercooling results in effective compression in the high-pressure compressor resulting in the reduction of the overall work done.

6. What do P_C and P_E represent?

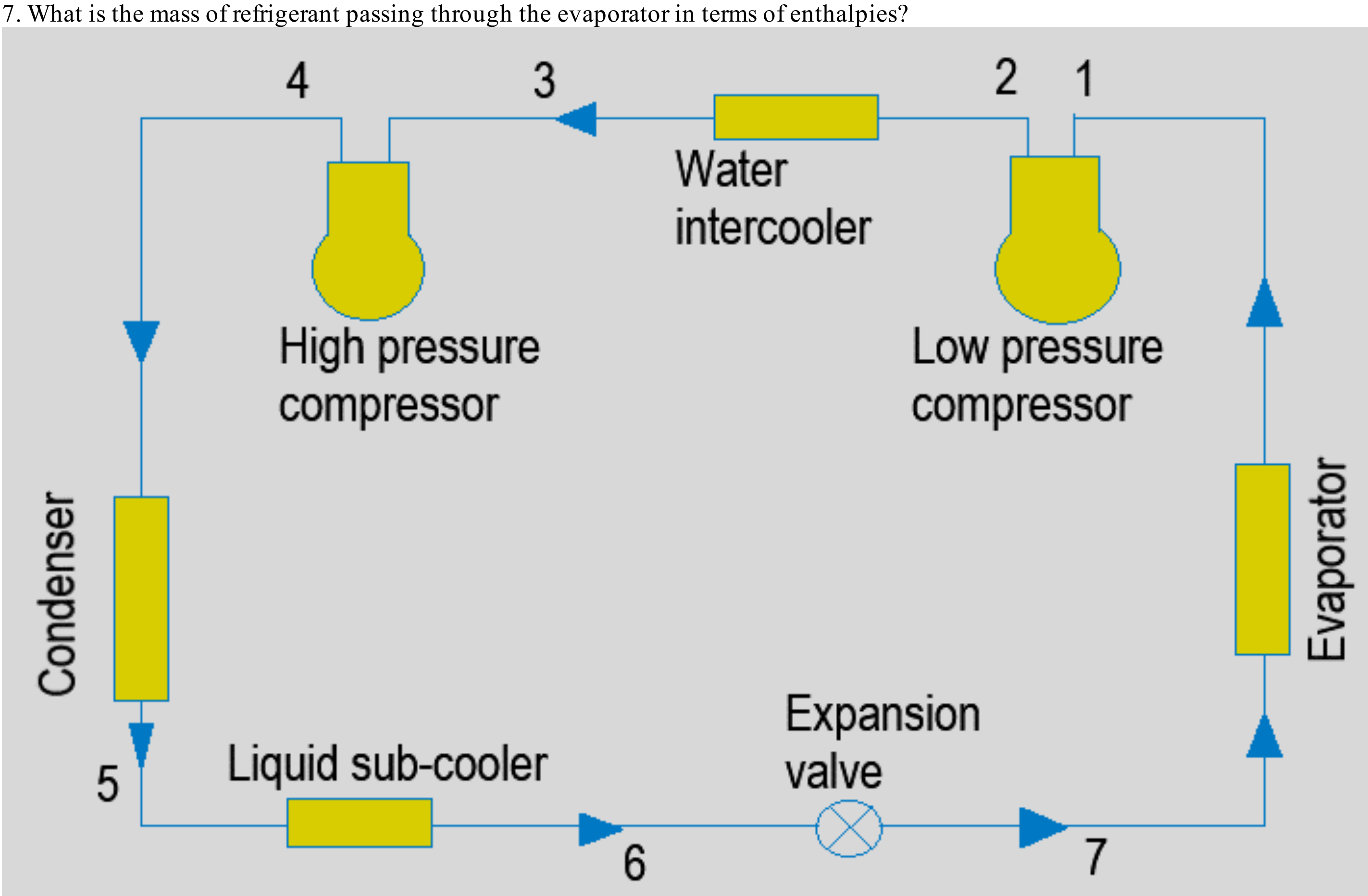


-

a) Evaporator and expansion pressure
b) Compression and expansion pressure
c) Condenser and evaporator pressure
d) Intercooling pressure

Answer: c
Explanation: P_C is for condenser pressure. The pressure at which latent heat is rejected from the refrigerant and converting vapour form to liquid form. P_E is for evaporator pressure. The pressure at which latent heat of vaporization is absorbed from the medium and phase change from liquid to vapour is carried out. Attaining and maintaining these pressures is essential for the smooth operation of the cycle.

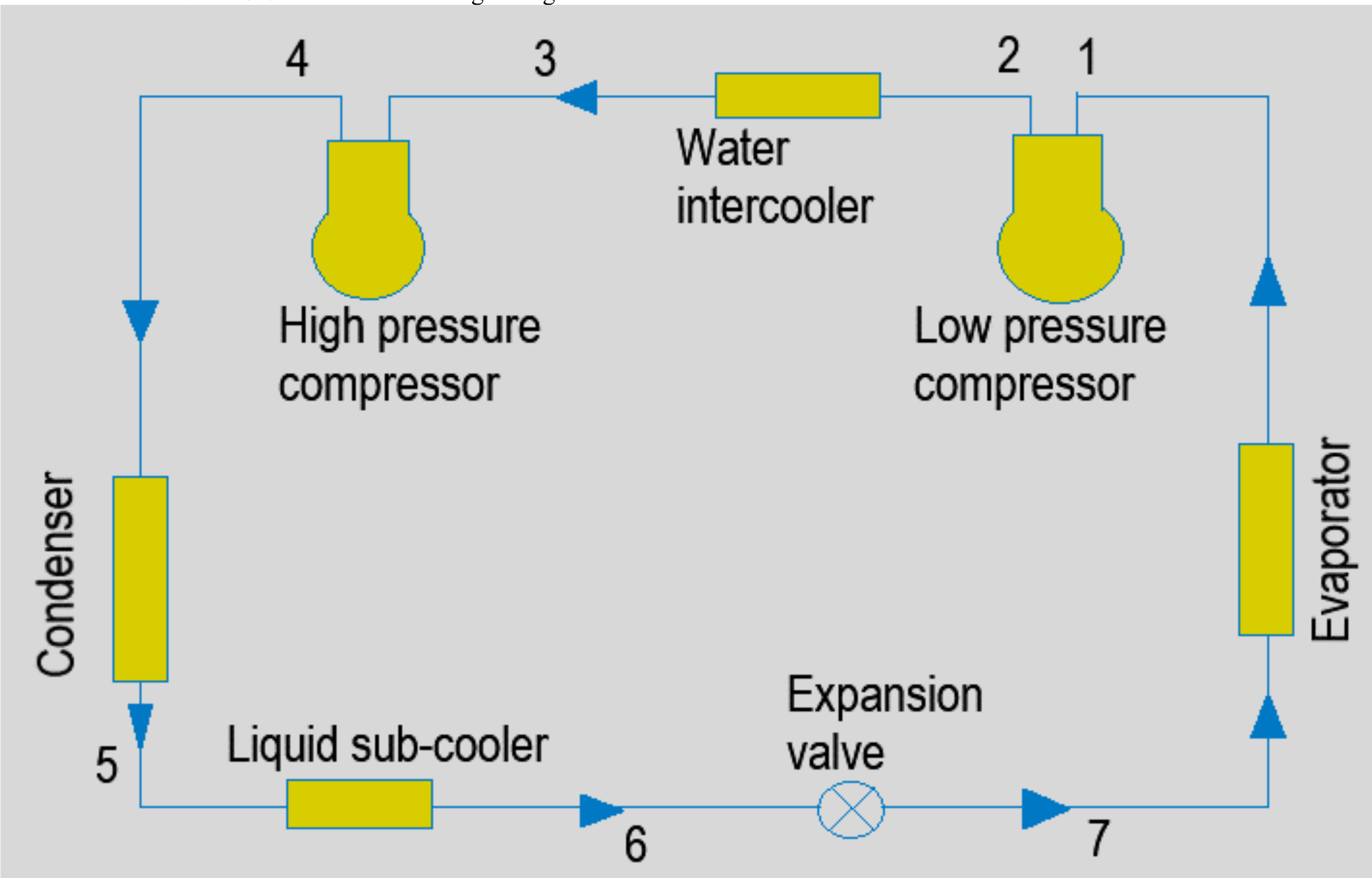
7. What is the mass of refrigerant passing through the evaporator in terms of enthalpies?

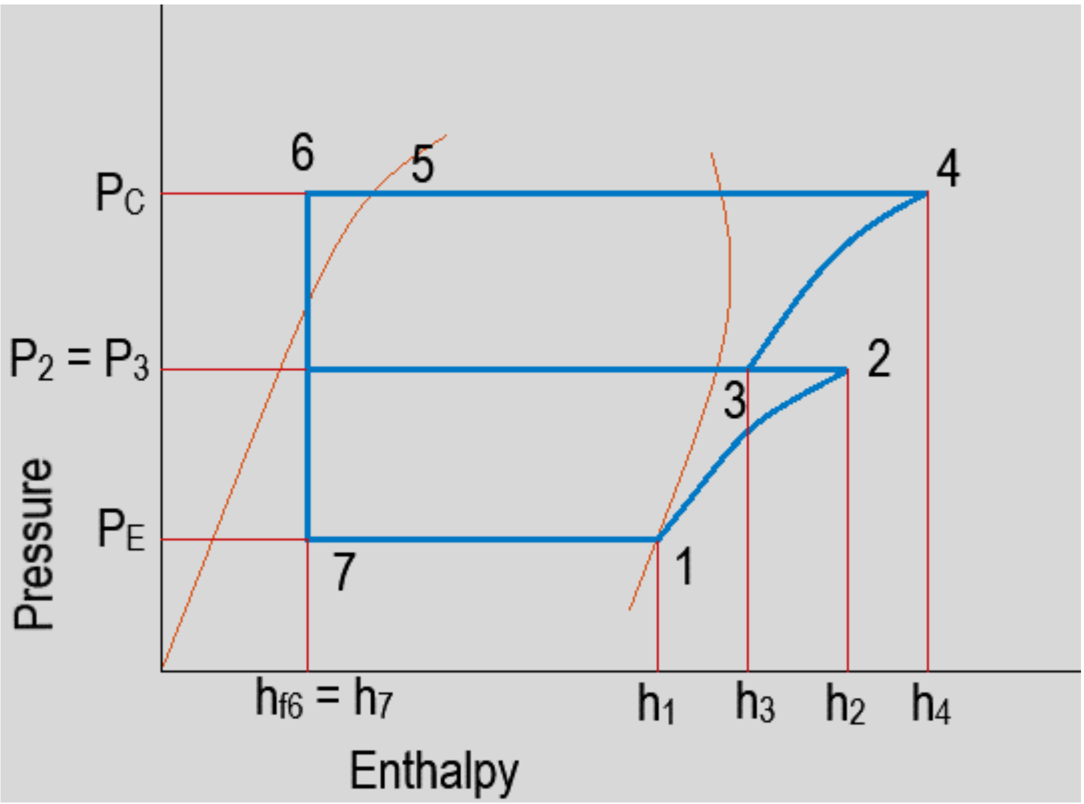


a) 210 Q / (h$_1$ â€“ h$_2$)
b) 210 Q / (h$_2$ â€“ h$_3$)
c) 210 Q / (h$_1$ â€“ h$_4$)
d) 210 Q / (h$_1$ â€“ h$_7$)

Answer: d
Explanation: The mass of refrigerant flowing in this type of arrangements is m, and the same amount of refrigerant flows through every equipment of the arrangement. As the refrigeration effect is the mass flowing through the evaporator times the enthalpy change across it.
Hence, m = R.E. / delta (h)
R.E. = TR = 210 Q kJ/min = 3.5 Q kW
Delta (h) = h$_1$ â€“ h$_{f6}$ = h$_1$ â€“ h$_7$
m = 210 Q / (h$_1$ â€“ h$_7$).

8. What is the value of C.O.P. for the following arrangement?

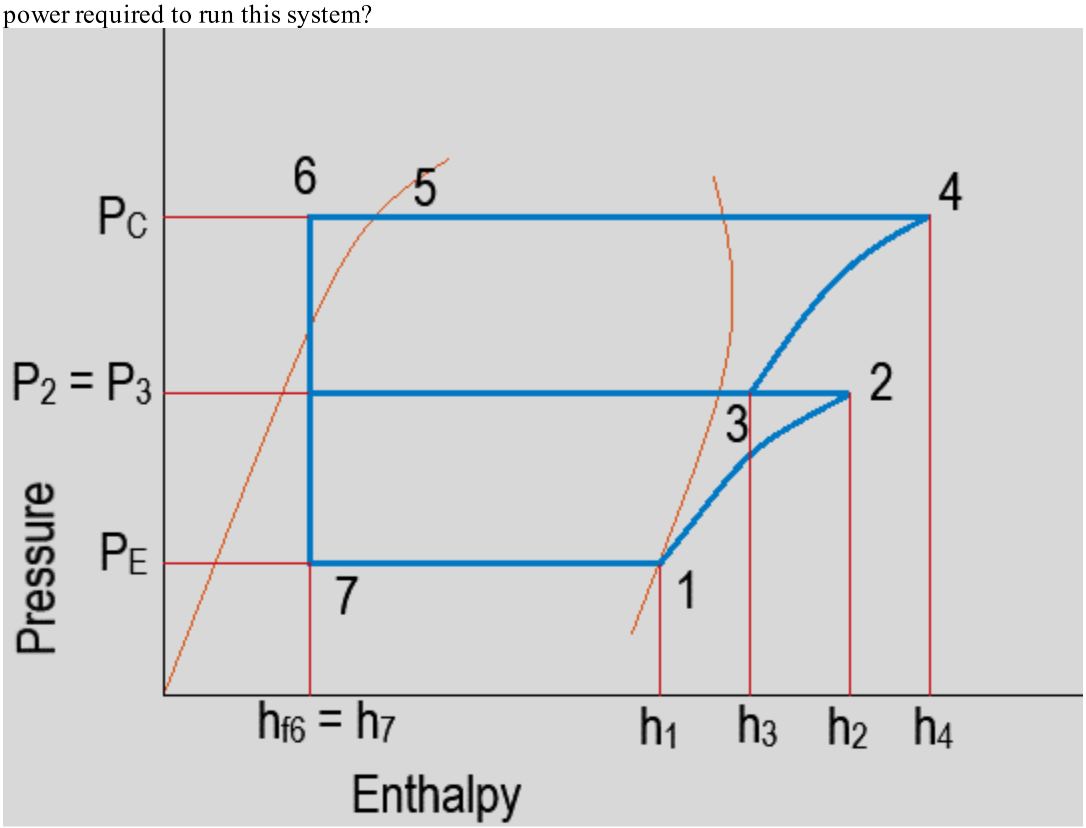




a) (h $_1$ â€“ h $_{f6}$) / (h $_2$ â€“ h $_1$) â€“ (h $_4$ â€“ h $_3$)
b) (h $_1$ â€“ h $_{f6}$) / (h $_2$ â€“ h $_1$) + (h $_4$ â€“ h $_3$)
c) (h $_1$ â€“ h $_{f6}$) / (h $_2$ â€“ h $_1$)
d) (h $_1$ â€“ h $_{f6}$) / (h $_4$ â€“ h $_3$)

Answer: b
Explanation: C.O.P. = Refrigeration effect / work
Hence, by taking the help of above diagrams,
R.E. = Heat absorbed in the evaporator
= mass flowing through the evaporator x enthalpy change
= m_1 (h_1 â€“ h_{f6}) as, h_{f6} = h_7
Work = Work done by low-pressure compressor + Work done by high-pressure compressor
= mass of refrigerant flowing through the low-pressure compressor x enthalpy change + mass of refrigerant flowing through the high-pressure compressor x enthalpy change
Work = m_1 (h_2 â€“ h_1) + m_2 (h_4 â€“ h_3) but here m_1 = m_2
Hence, C.O.P. = m_1 (h_1 â€“ h_{f5}) / m_1 (h_2 â€“ h_1) + m_2 (h_4 â€“ h_3)
= (h_1 â€“ h_{f6}) / (h_2 â€“ h_1) + (h_4 â€“ h_3).

9. In a compound vapour compression system, the mass flow rate of 2 kg/min is observed. The enthalpies related to point 1, 2, 3 and 4 in the following figure are 1350, 1580, 1540 and 1650 kJ/kg respectively. What is the amount of power required to run this system?

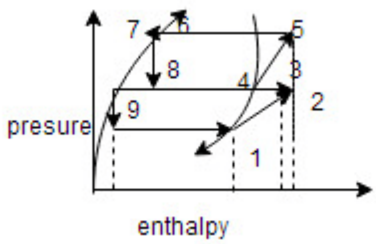


a) 11.33 kW
b) 22.66 kW
c) 680 kW
d) 5.67 kW

Answer: a
Explanation: Given: m = 2 kg/min
h_1 = 1350 kJ/kg
h_2 = 1580 kJ/kg
h_3 = 1540 kJ/kg
h_4 = 1650 kJ/kg
As, work = m [(h_2 â€“ h_1) + (h_4 â€“ h_3)]
= 2 [(1580 â€“ 1350) + (1650 â€“ 1540)]
= 2 [230 + 110]
= 680 kJ/min
Power required = Work / 60
= 680 / 60
= 11.33 kW.

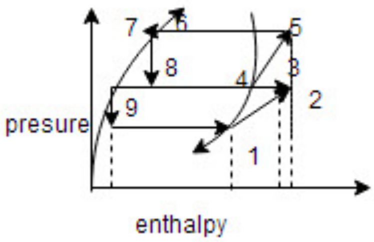
This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œTwo/Multi Stage Compression with Water Intercooling, Liquid Subcooling and Flash Chamber â€“ 1â€�.

1. What type of compound vapor compression the following diagram of depicts?



a) Two stage vapor compression with liquid intercooler and flash chamber
b) Three stage vapor compression with water intercooler and liquid subcooler
c) Two stage vapor compression with flash intercooler
d) Two stage vapor compression with water intercooler, liquid subcooler and flash intercooler

Answer: d
Explanation:



The diagram itself shows that it consists of two stage vapor compression with liquid sub cooler as shown in the process (5 â€“ 6) and water intercooler from the process (1 â€“ 2) and (3 â€“ 4) and flash chamber is used during processes (7 â€“ 8) and (8 â€“ 9).

2. The heat taken and given by the flash chamber is same.
a) True
b) False

Answer: a
Explanation: The heat taken and given by the flash chamber is same as the flash chamber is an insulated vessel; hence there is no heat exchange between the flash chamber and the atmosphere.

3. Find the coefficient of performance when the refrigeration effect (Re) is 145.7 and the work done (W) is 32.46 KJ.
a) 4.5
b) 5.5
c) 4.6
d) 5.6

Answer: a
Explanation: COP = \(\frac{210Ã—Q}{W}\)
COP = \(\frac{Re}{W} = \frac{145.7}{32.46}\)
= 4.5.

4. By using flash chambers the total work done per kg of refrigerant is reduced.
a) True
b) False

Answer: a
Explanation: By using flash chambers the total work done per kg of refrigerant is reduced as the refrigerant can be expanded close to the liquid line and hence work done per kg reduces.

5. Which one of the following is not an advantage of water intercooling when used in a multi stage compression?
a) Reduces the work to be done in high pressure
b) Reduces the specific volume of the refrigerant
c) Requires a compressor of more stroke volume
d) Requires a compressor of less stroke volume

Answer: c
Explanation: When water intercooling is used in a multi stage compression the work to be done in high pressure is reduced, the specific volume of the refrigerant is reduced and a compressor of less stroke volume is required.

6. What is the value of Refrigeration effect if $m_2 = 2$ kg/min, $m_3 = 0.8$ kg/min and enthalpies for the refrigerant at saturated vapor and saturated liquid line are 1420 and 1260 kJ/kg?
a) 192
b) 194
c) 196
d) 129

Answer: a
Explanation: Given: $m_2 = 2$ kg/min
$m_3 = 0.8$ kg/min
$h_1 = 1420$ kJ/kg and $h_{f10} = h_{11} = 1260$ kJ/kg
As, $m_1 = m_2$ â€“ m_3
= 2 â€“ 0.8
= 1.2
Refrigeration effect = m_1 (h_1 â€“ h_{11})
= 1.2 (1420 â€“ 1260)
= 1.2 x 160
= 192 kJ/min.

This set of Basic Refrigeration Questions and Answers focuses on â€œTwo/Multi Stage Compression with Water Intercooling, Liquid Subcooling and Flash Intercoolerâ€�.

1. Why is multi-stage or compound VCR with water intercooler, liquid sub-cooler, and flash intercooler used?
a) To improve C.O.P.
b) To decrease refrigeration effect
c) To increase work
d) To increase leakage loss

Answer: a
Explanation: By de-superheating or intercooling the refrigerant before the second stage compression but not till the saturated vapor line, can decrease the total work required. By using the liquid sub-cooler, subcooling is done, and an increase in the refrigeration effect is achieved. Use of flash intercooler ensures separation of vapor and liquid form of refrigeration and acts as an intercooler too, which helps to reduce the work. So, the increase in R.E. and decrease in work improves the C.O.P. of the system.

2. What is the purpose of using intercooler?
a) To increase the cost of the compressor
b) To cool the superheated refrigerant
c) To re-heat superheated refrigerant
d) To reduce the volumetric efficiency

Answer: b
Explanation: Intercooler is used to cool the superheated refrigerant by some amount but in this case, not till the saturated vapor line. The superheated refrigerant leaving the first compressor is cooled by suitable method before entering the second compressor. This type of cooling is known as intercooling.

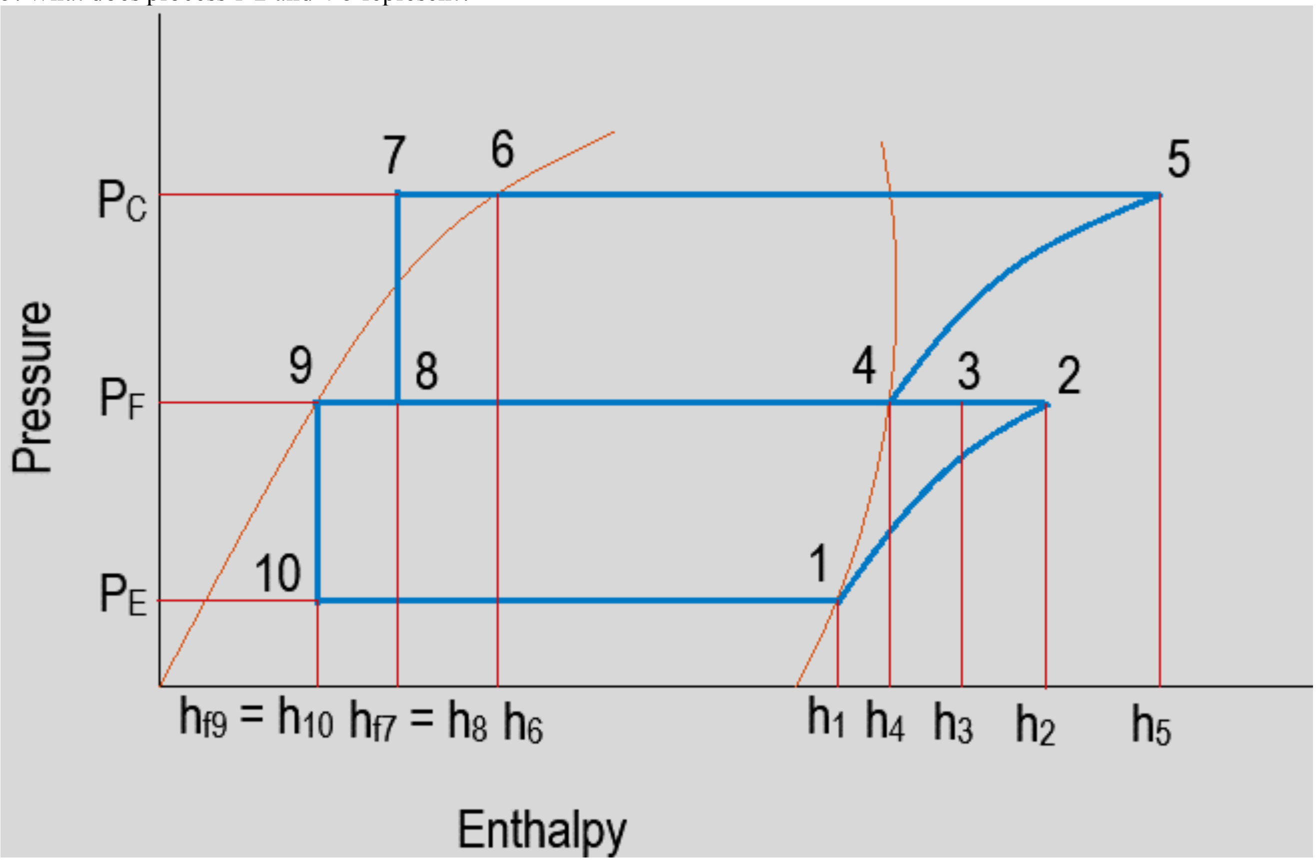
3. What is the purpose of using liquid sub-cooler?
a) To increase the cost of the compressor
b) To reduce the volumetric efficiency
c) To re-heat superheated refrigerant
d) To increase the refrigeration effect

Answer: d
Explanation: Liquid sub-cooler is used to sub-cool the liquid refrigerant coming from the condenser beyond the saturated liquid line. Sub-cooling results in an increase in refrigeration effect and thus increasing the C.O.P.

4. What is the purpose of using a flash intercooler?
a) To increase pressure
b) To decrease pressure
c) To separate vapor and liquid refrigerant and de-superheat
d) To evaporate refrigerant partially

Answer: c
Explanation: Flash intercooler is the combination of flash chamber and intercooler. Flash chamber is used to separate vapor and liquid refrigerant. It is an insulated container and separates both forms by using the centrifugal effect. Intercooler decreases the temperature to the saturated vapor line before entering the second stage of compression.

5. What does process 1-2 and 4-5 represent?

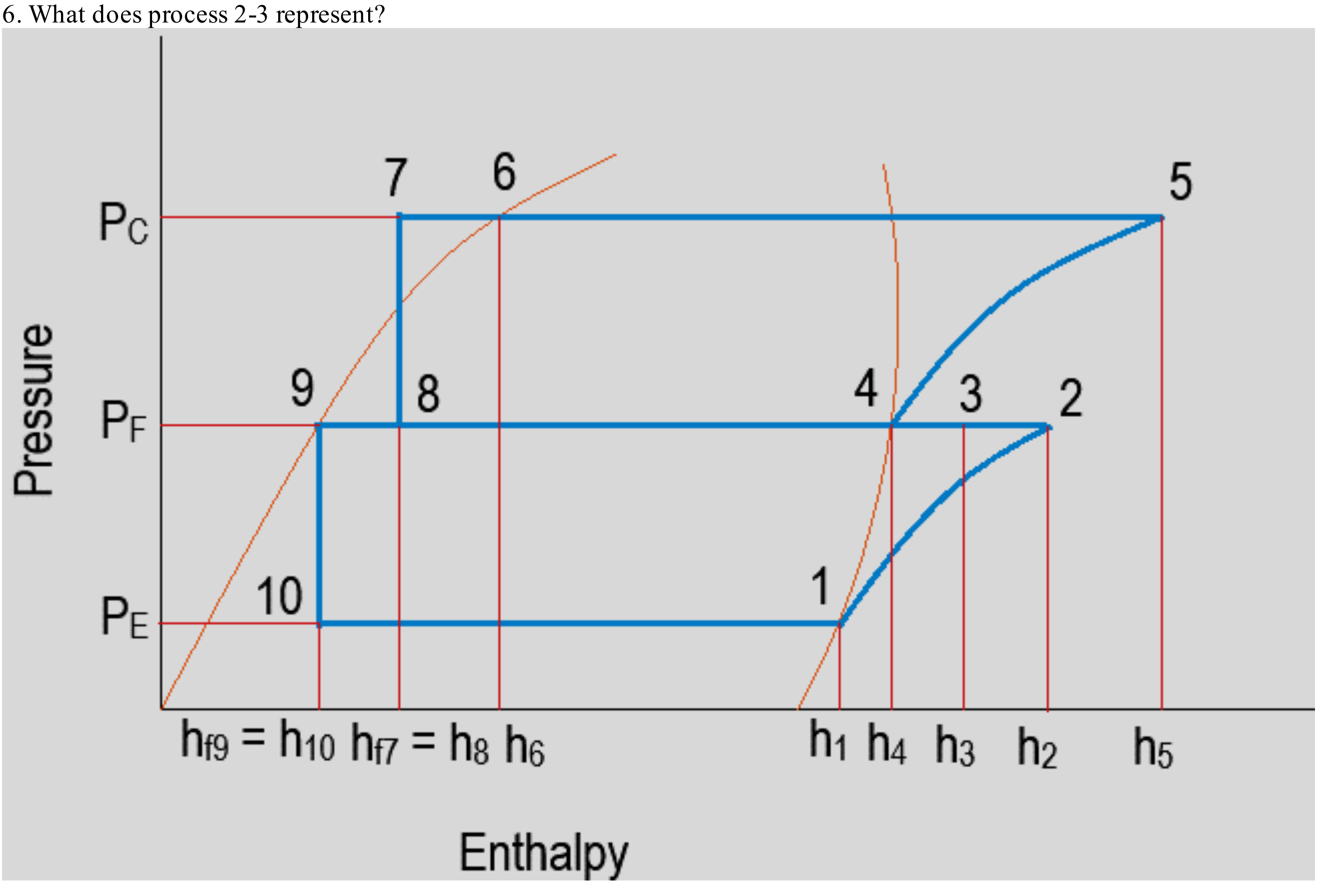


a) Evaporation
b) Compression

c) Condensation
d) Expansion

Answer: b
Explanation: Process 1-2 and 4-5 represent compression. This type of compression is isentropic compression, which is carried out in two stages. The first compression is carried out in low-pressure compressor and then compressed in the high-pressure compressor.

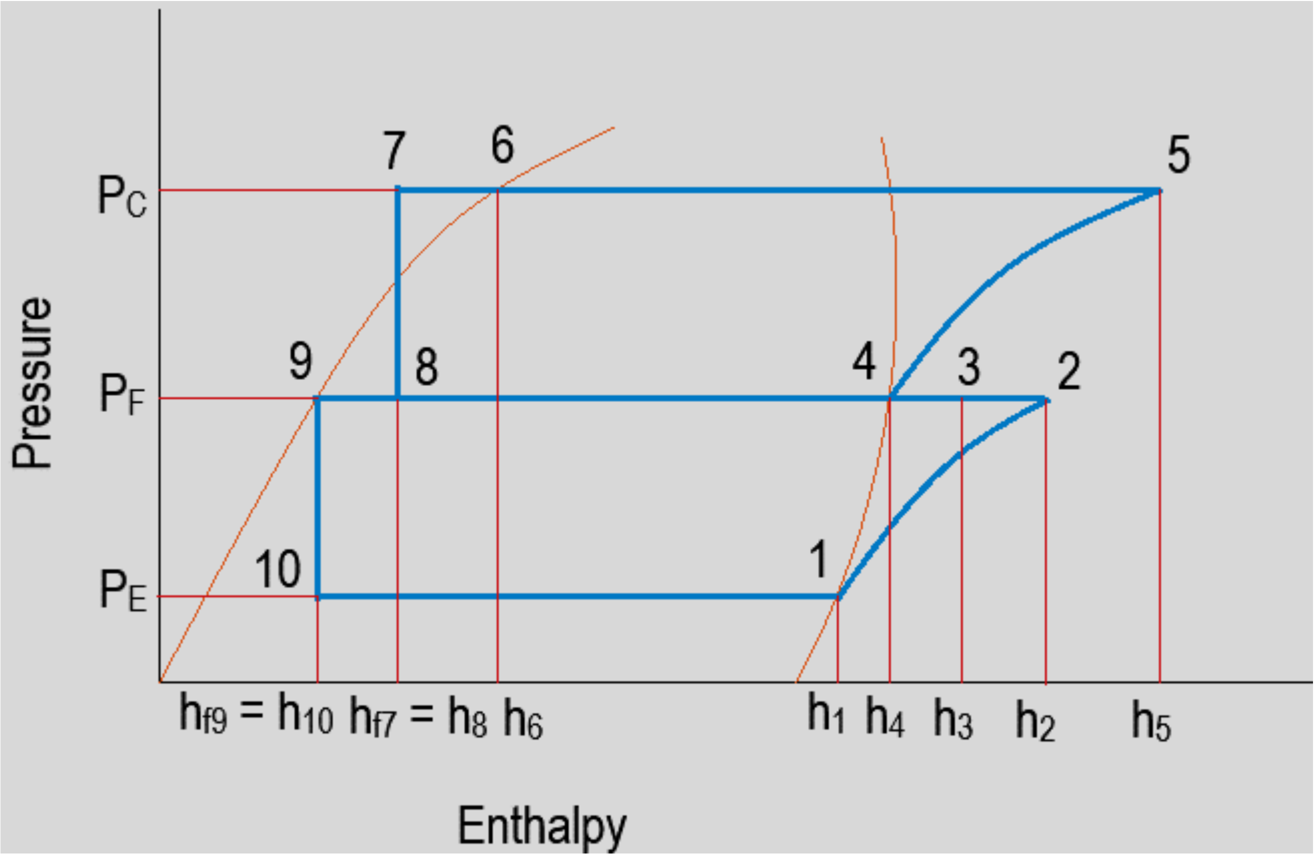
6. What does process 2-3 represent?



a) Evaporation
b) Compression
c) Intercooling
d) Condensation

Answer: c
Explanation: Process 2-3 represent intercooling or de-superheating. Intercooling is carried out to some extent but not till the saturated vapor line before the second stage of compression. Intercooling results in effective compression in the high-pressure compressor resulting in the reduction of the overall work done.

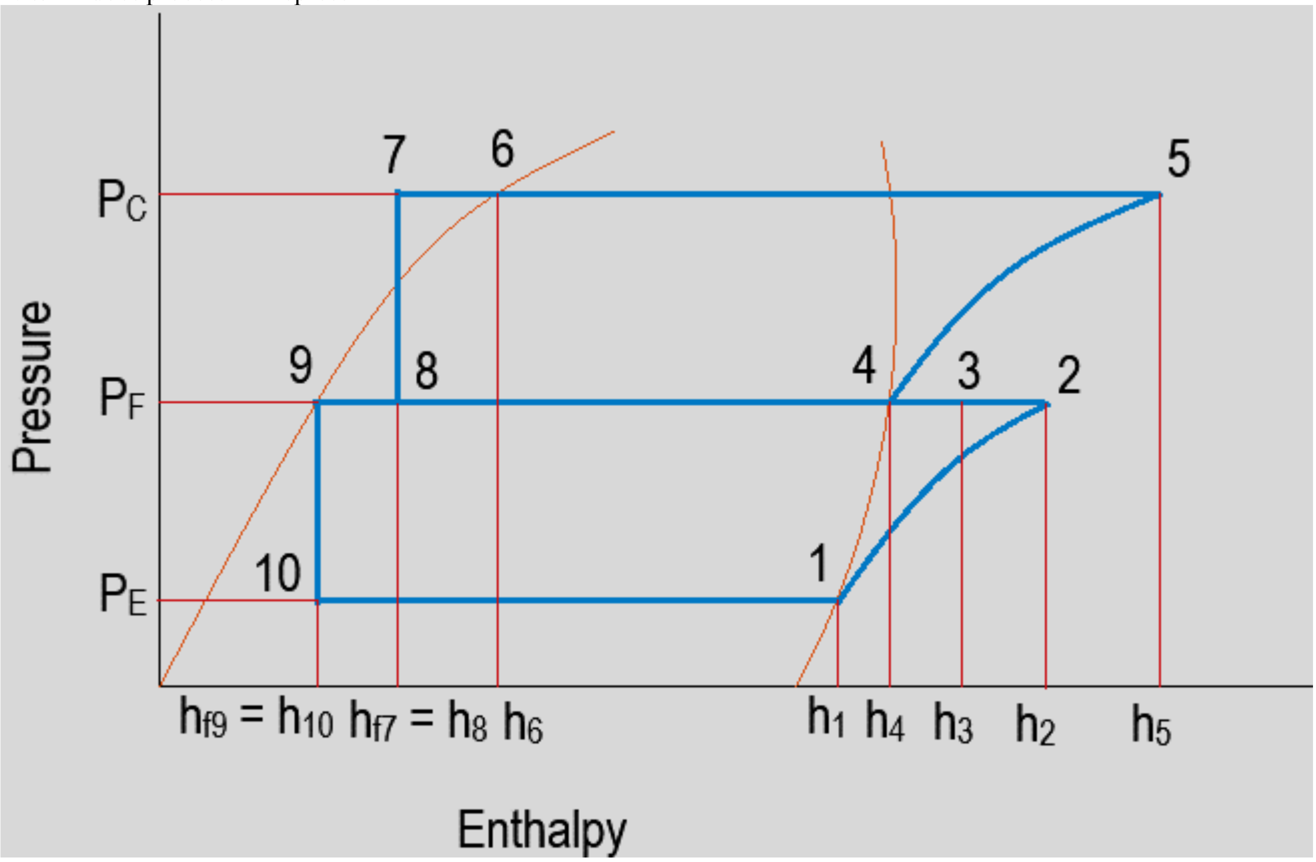
7. What do P_C, P_E, and P_F represent?



a) Evaporator, expansion and flash chamber pressure
b) Compression, expansion and flash chamber pressure
c) Condenser, evaporator and flash chamber pressure
d) Intercooling pressure

Answer: c
Explanation: P_C is for condenser pressure. The pressure at which latent heat is rejected from the refrigerant and converting vapor form to liquid form. P_E is for evaporator pressure. The pressure at which latent heat of vaporization is absorbed from the medium and phase change from liquid to vapor is carried out. P_F is for flash chamber pressure, the pressure at which liquid and vapor refrigerants are separated. Attaining and maintaining these pressures is essential for the smooth operation of the cycle.

8. What does process 3-4 represent?

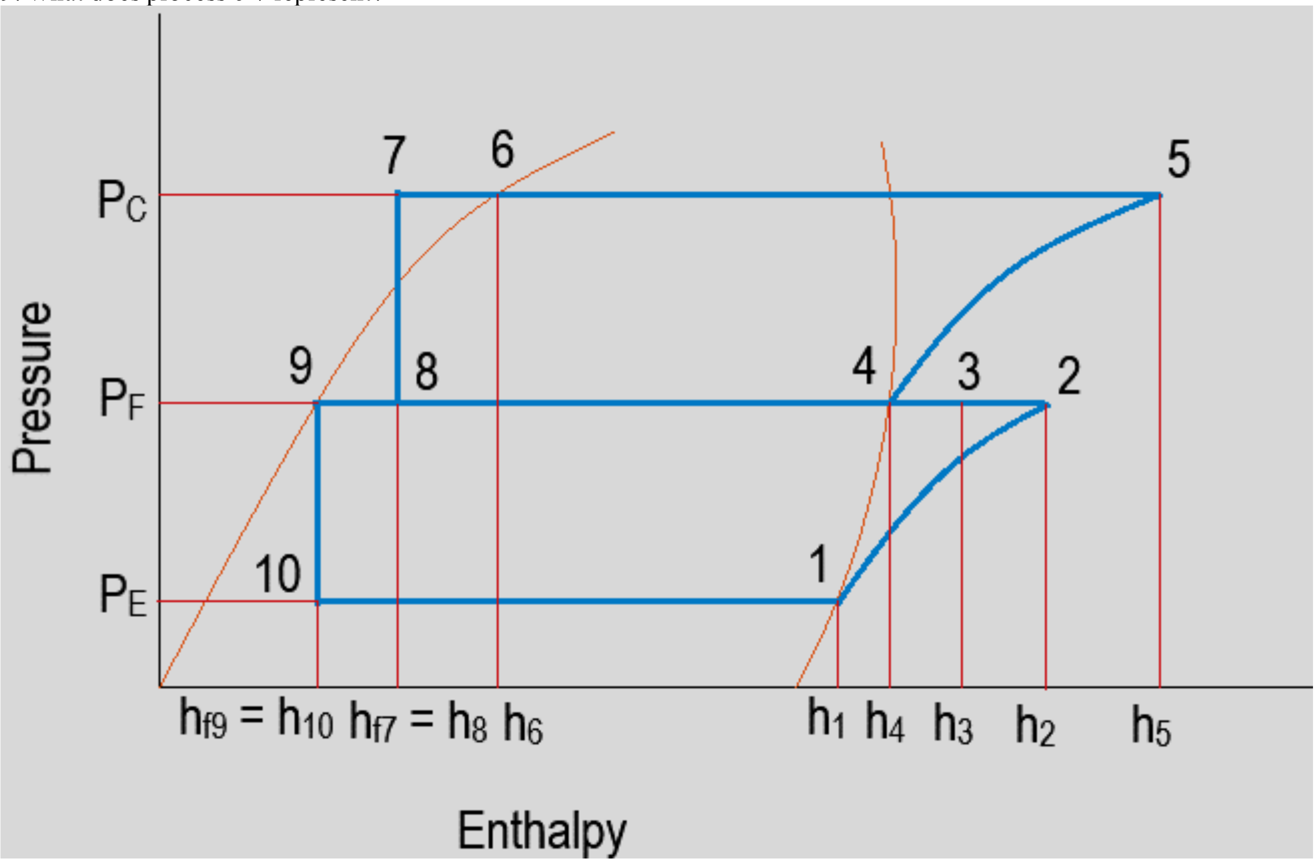


a) Separation of refrigerant and de-superheating
b) Compression
c) Mixing of refrigerants
d) Condensation

Answer: a
Explanation: Process 3-4 represent the separation of vapor and liquid form of refrigerant using the flash intercooler for effective compression. De-superheating or intercooling is also carried out to get the refrigerant to the saturated

vapor state before entering the second stage of compression. Use of flash intercooler or process 3-4 ensures precise compression, reducing the overall work, and increasing the C.O.P.

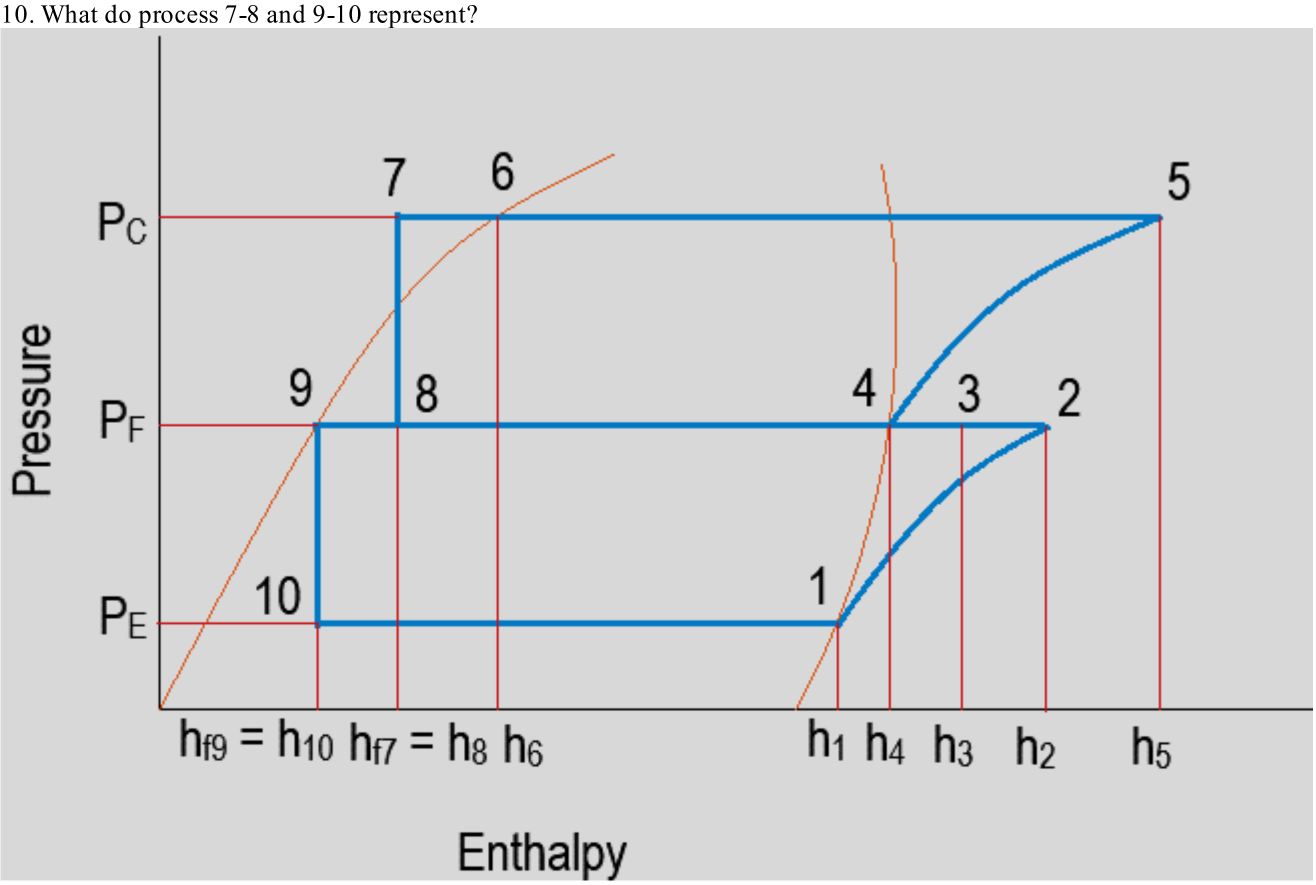
9. What does process 6-7 represent?



a) Evaporation
b) Compression
c) Mixing of refrigerant coming from the flash chamber
d) Sub-cooling

Answer: d
Explanation: Process 6-7 represent sub-cooling. The liquid refrigerant coming from the condenser is cooled further by the circulation of colder water to increase the refrigeration effect and improving the C.O.P. of the system.

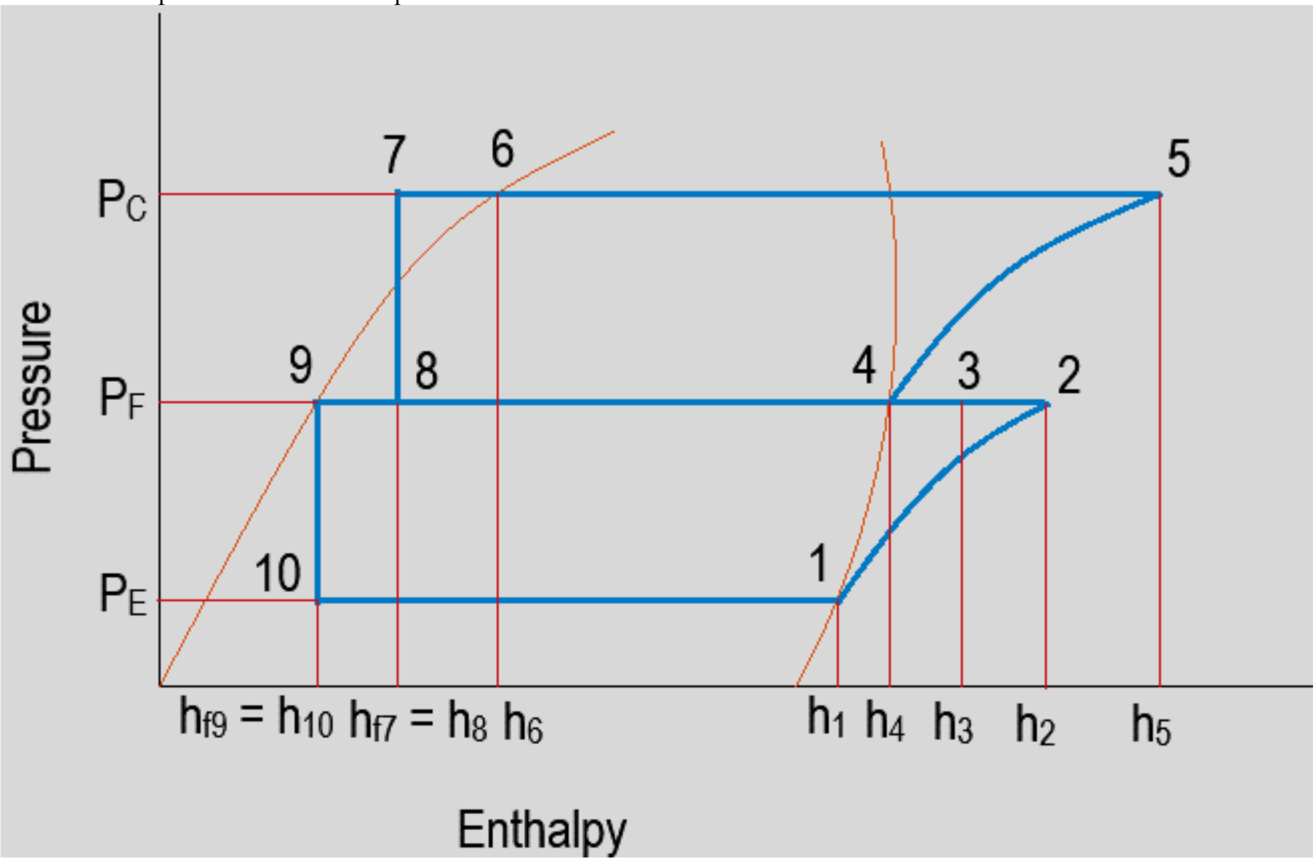
10. What do process 7-8 and 9-10 represent?



a) Expansion
b) Compression
c) Mixing of refrigerant coming from the flash chamber
d) Sub-cooling

Answer: a
Explanation: Process 7-8 and 9-10 represent expansion process. The subcooled liquid is expanded in the first expansion valve. Then after the separation of refrigerant in the flash intercooler, it is passed through the second expansion valve to do the expansion process.

11. What does process 8-9 and 8-4 represent?

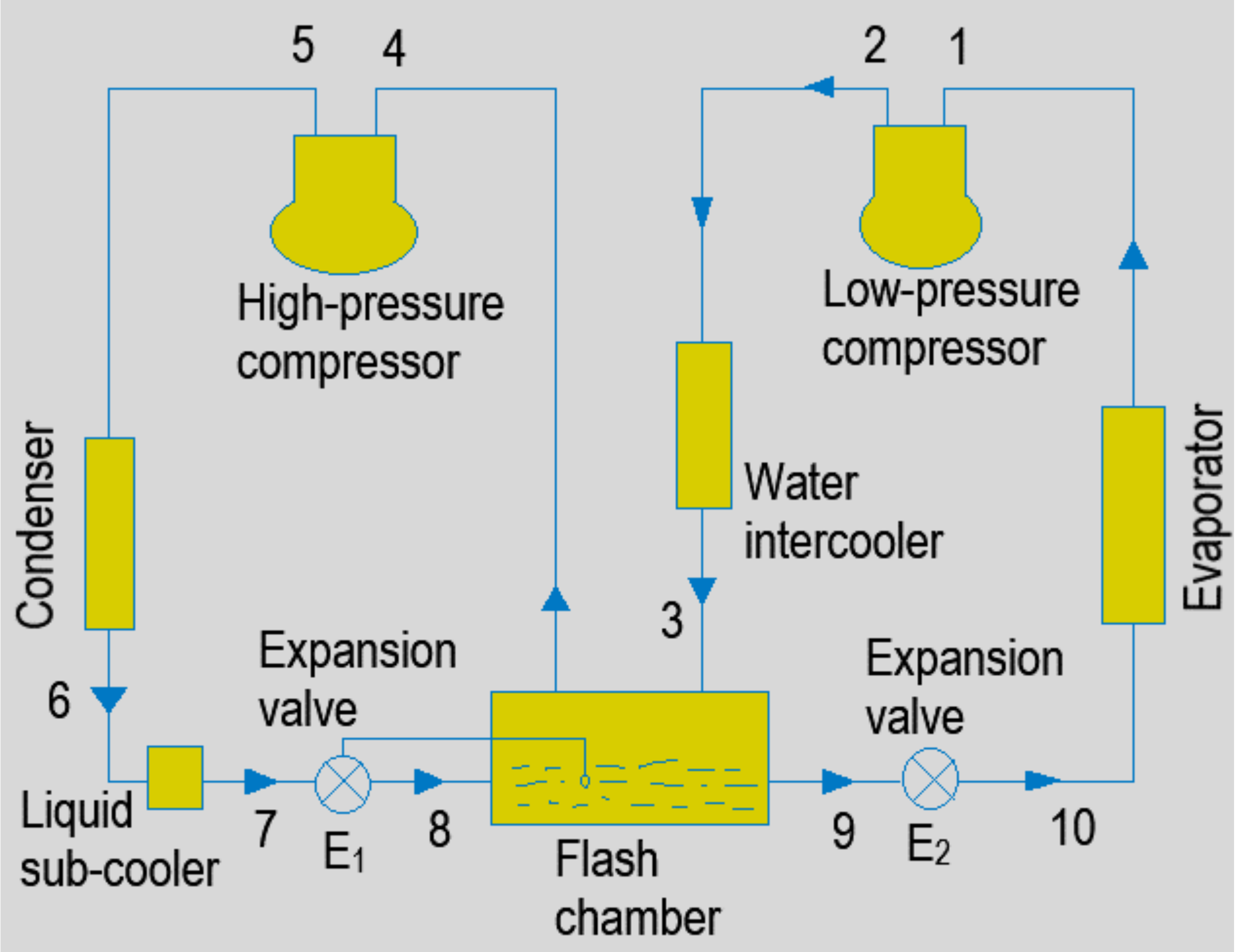


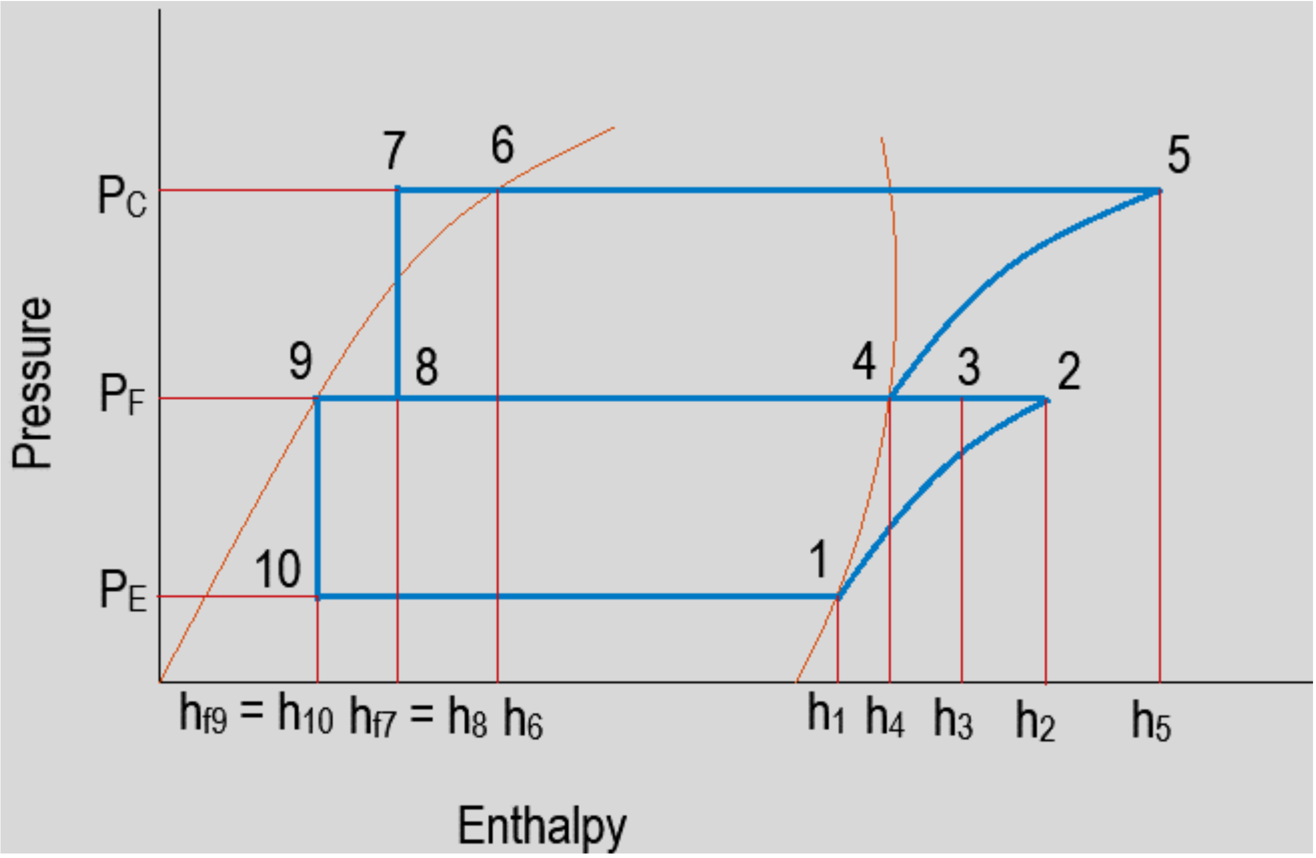
a) Expansion
b) Separating the vapor and liquid form of refrigerant
c) Compression

d) Sub-cooling

Answer: b
Explanation: Process 8-9 and 8-10 represent separating the liquid and vapor form of refrigerant. Process 8-9 ensures vapor refrigerant is transferred to the second stage of the compressor. Separates the pure dry saturated vapor and discharges to the vapor coming out of first stage compression. Process 8-10 ensures the saturated liquid is sent to the second expansion valve. The refrigerant reaches a saturated liquid line, and it is expanded.

12. What is the ratio of m_2 / m_1 for the following arrangement?





If, m_1 = Mass of refrigerant passing through the evaporator

m_2 = Mass of refrigerant passing through condenser

a) (h_1 â€“ h_{f6}) / (h_2 â€“ h_1) â€“ (h_4 â€“ h_3)

b) (h_1 â€“ h_{f6}) / (h_2 â€“ h_1) + (h_4 â€“ h_3)

c) (h_8 â€“ h_{f10}) / (h_9 â€“ h_{f10})

d) (h_3 â€“ h_{f9}) / (h_4 â€“ h_8)

Answer: d

Explanation: Flash chamber is an insulated vessel. Hence, there is no heat exchange between flash chamber and surrounding. Considering the thermal equilibrium,

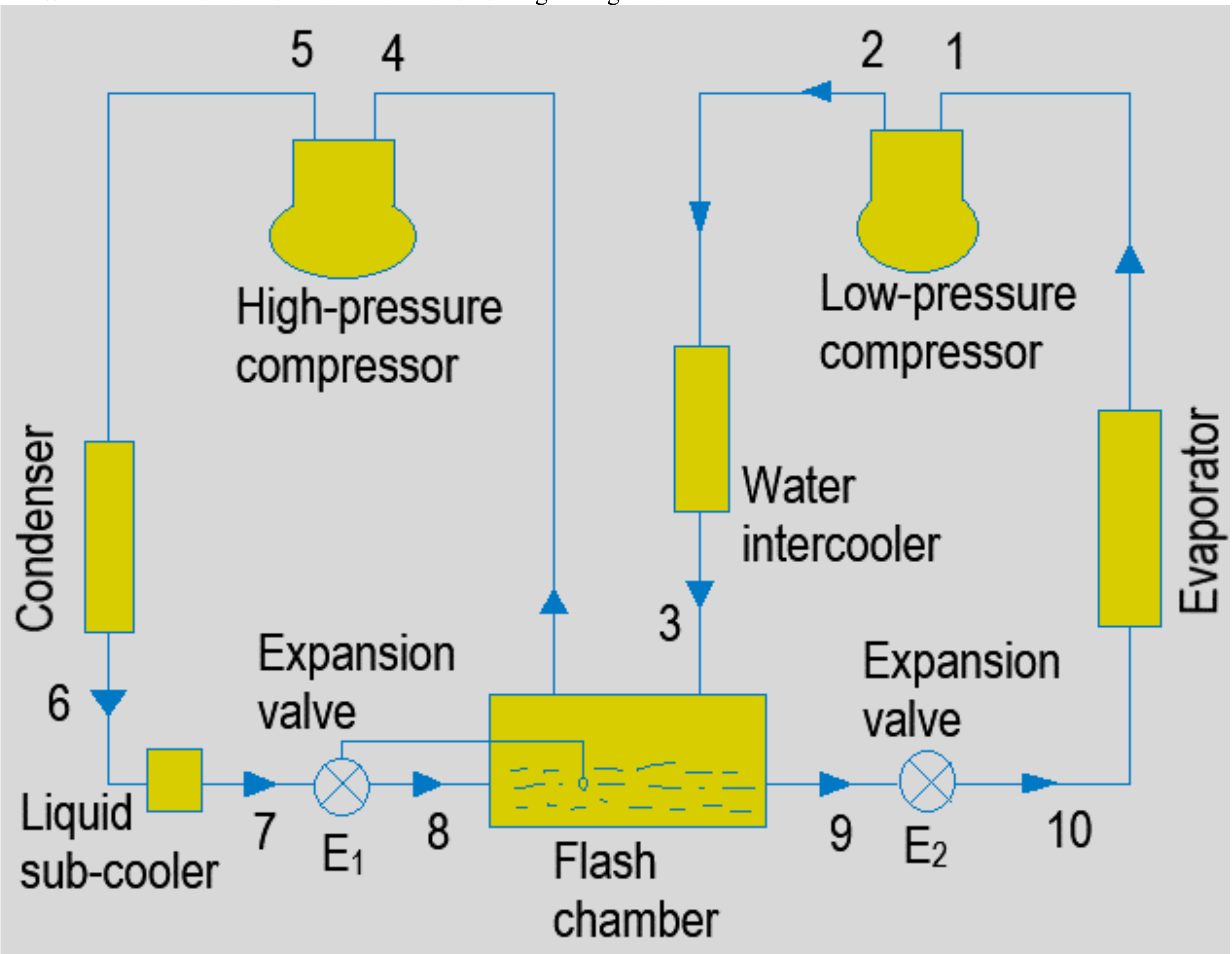
Heat taken by the flash chamber = Heat given by the flash chamber

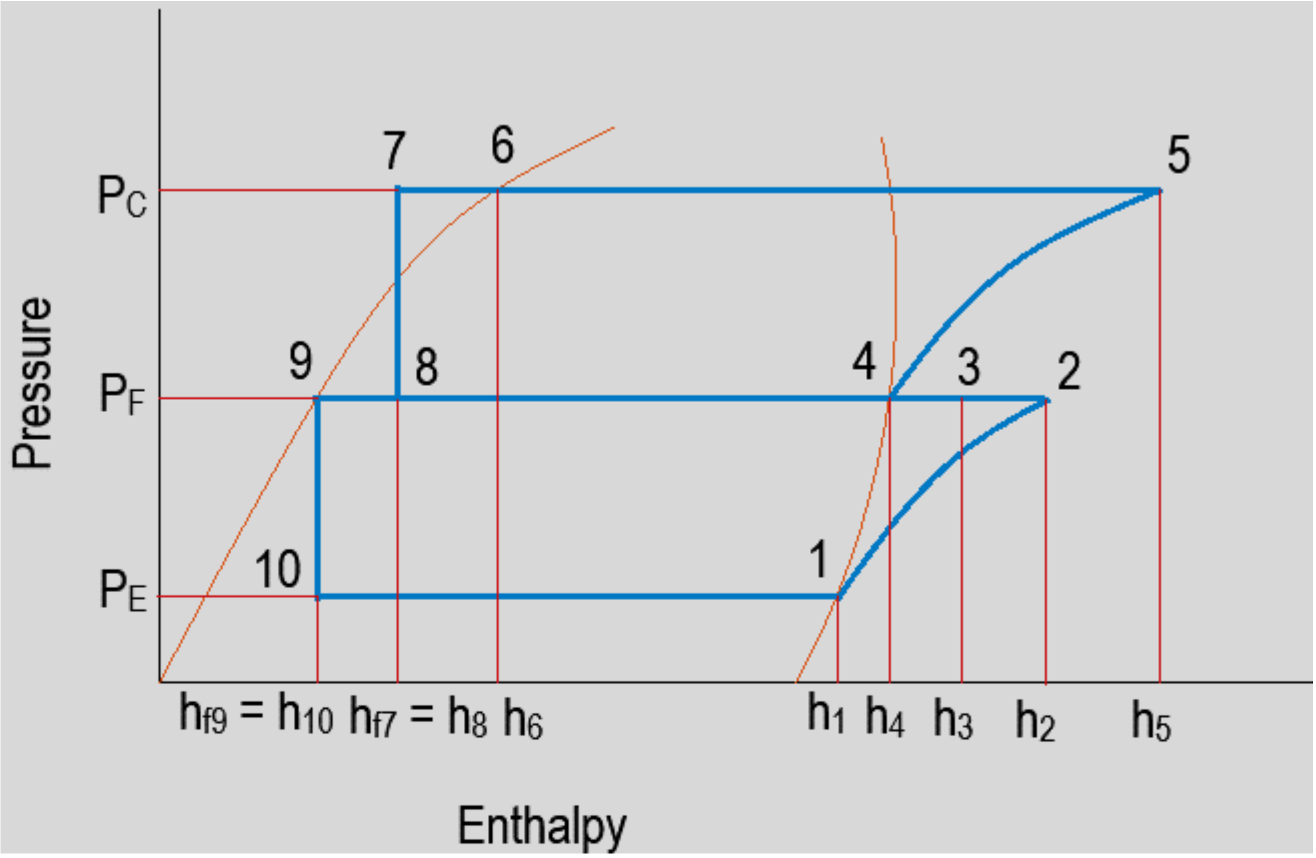
$m_2 h_8 + m_1 h_3 = m_1 h_{f9} + m_2 h_4$

$m_1 (h_3 \text{ â€“ } h_{f9}) = m_2 (h_4 \text{ â€“ } h_8)$

$m_2 / m_1 = (h_3 \text{ â€“ } h_{f9}) / (h_4 \text{ â€“ } h_8)$.

13. What is the value of work done for the following arrangement?





If, m_1 = Mass of refrigerant passing through the evaporator

m_2 = Mass of refrigerant passing through the condenser

a) m_1 (h_2 â€“ h_1) + m_2 (h_4 â€“ h_3)

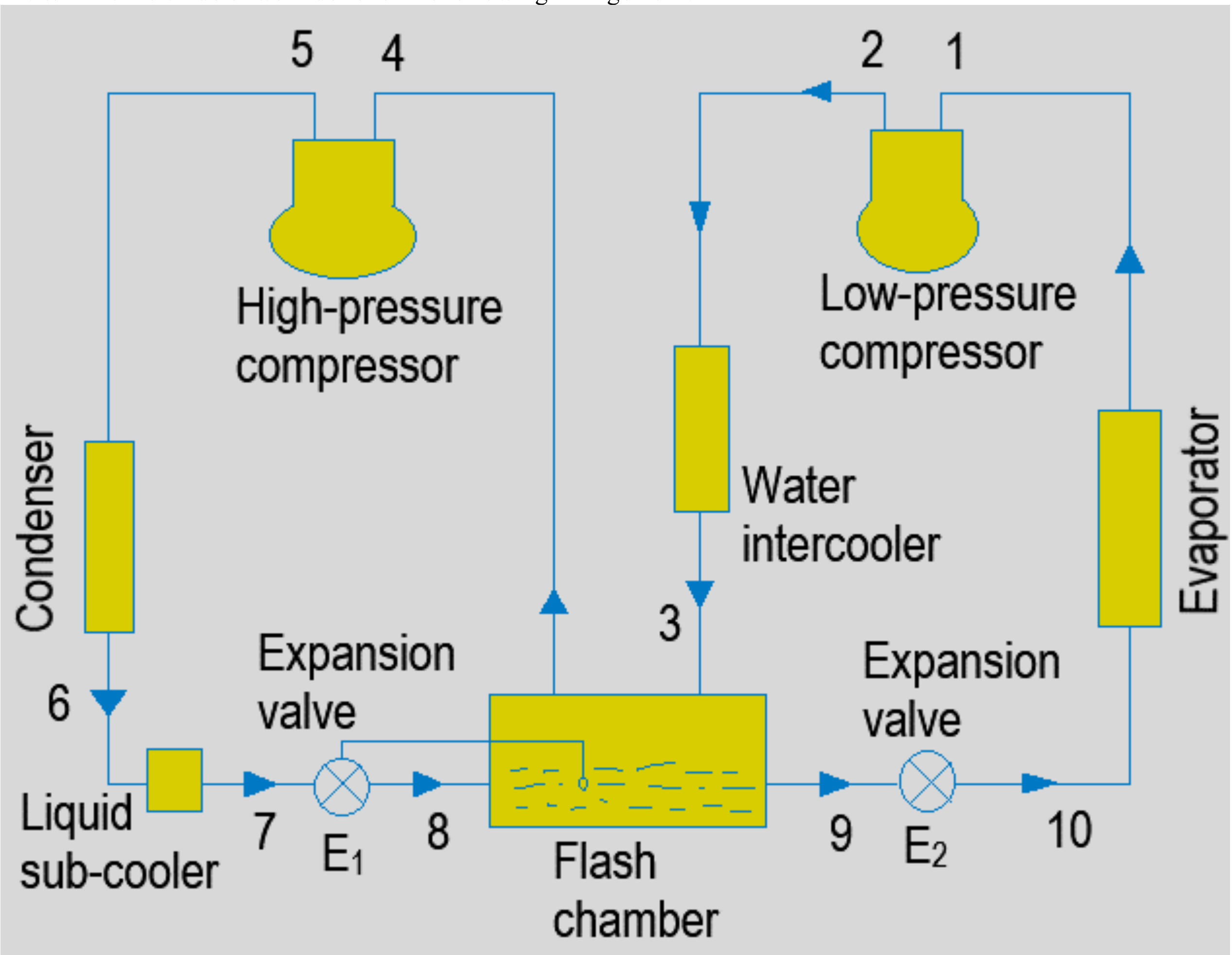
b) (h_1 â€“ h_{f10}) / (h_4 â€“ h_9)

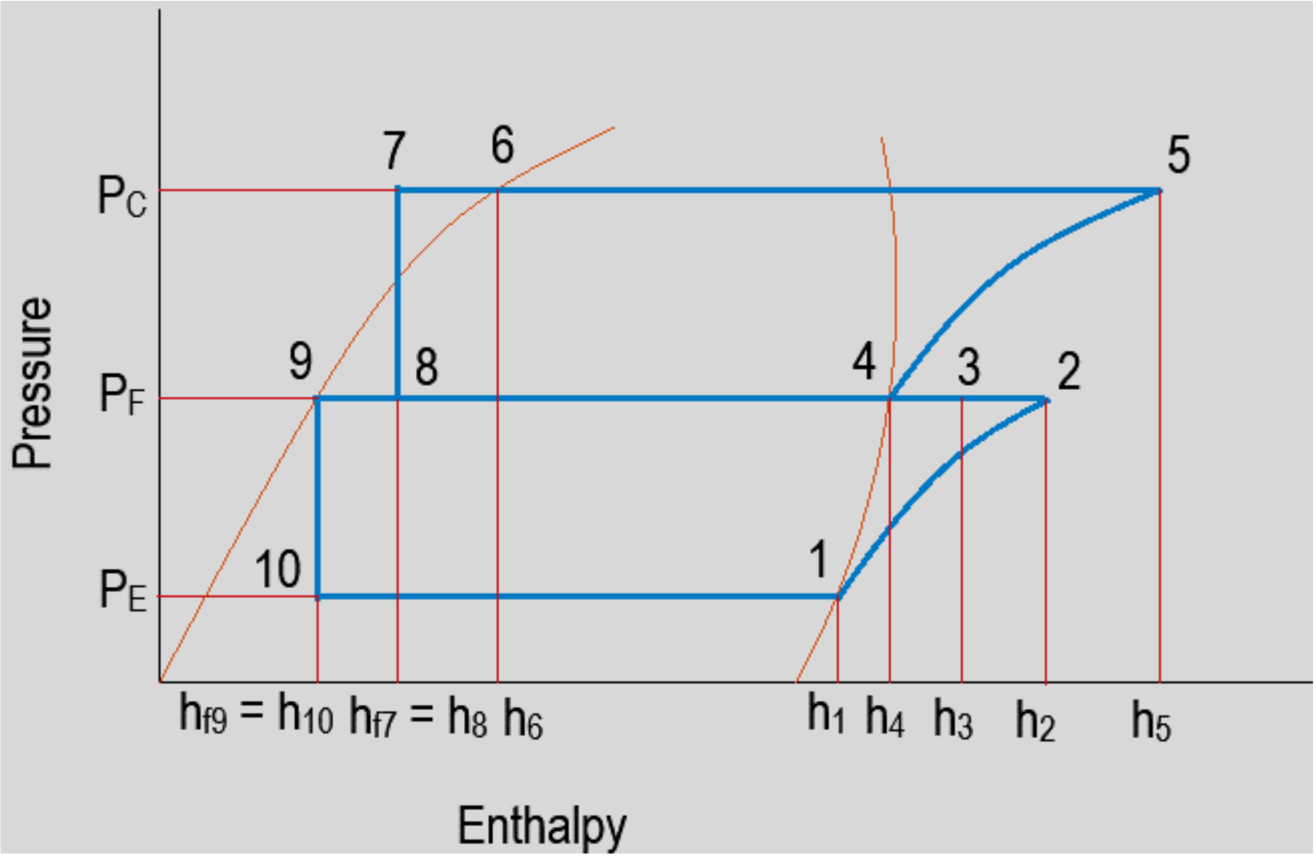
c) (h_8 â€“ h_{f10}) / (h_9 â€“ h_{f10})

d) m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4)

Answer: d
Explanation: By taking the help of above diagrams,
Work = Work done by low-pressure compressor + Work done by high-pressure compressor
= mass of refrigerant flowing through the low-pressure compressor x enthalpy change + mass of refrigerant flowing through the high-pressure compressor x enthalpy change
Work done by the low-pressure compressor = m_1 (h_2 â€“ h_1)
Work done by the high-pressure compressor = m_2 (h_5 â€“ h_4)
Total work = m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4).

14. What is the value of work done for the following arrangement?





If, m_1 = Mass of refrigerant passing through the evaporator

m_2 = Mass of refrigerant passing through condenser

a) m_1 (h_1 â€“ h_{f9}) / m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4)

b) m_3 (h_1 â€“ h_{f10}) / m_2 (h_4 â€“ h_9)

c) m_2 (h_8 â€“ h_{f10}) / m_1 (h_9 â€“ h_{f10})

d) m_1 (h_1 â€“ h_{11}) / m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4)

Answer: a
Explanation: As, C.O.P. = Refrigeration effect / Total work
Hence, by taking the help of above diagrams,
R.E. = Heat absorbed in the evaporator
= mass flowing through the evaporator x enthalpy change
= m_1 (h_1 â€“ h_{10}) as, h_{f9} = h_{10}
Work = Work done by low-pressure compressor + Work done by high-pressure compressor
= mass of refrigerant flowing through the low-pressure compressor x enthalpy change + mass of refrigerant flowing through the high-pressure compressor x enthalpy change
Total Work = m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4)
Hence, C.O.P. = m_1 (h_1 â€“ h_{f9}) / Total work
= m_1 (h_1 â€“ h_{f9}) / m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4).

15. What is the value of Refrigeration effect if m_1 = 4 kg/min, and enthalpies for the point 1, 2, 4, 5, 9 are 1350, 1550, 1480, 1620, and 280 kJ/kg. If the refrigeration effect is 4280 kJ/min and work done is 15 kW, then what is the value of C.O.P.?
a) 4.85
b) 5.50
c) 4.75
d) 6.00

Answer: c
Explanation: Given: m_1 = 4 kg/min
h_1 = 1350 kJ/kg
h_{f9} = h10 = 280 kJ/kg
h_2 = 1550 kJ/kg
h_4 = 1480 kJ/kg
h_5 = 1620 kJ/kg
As, enthalpies of all points is given but it is a redundant data cause direct values of refrigeration effect and work is given, hence C.O.P. can be found easily.
Refrigeration effect = m_1 (h_1 â€“ h_{11})
= 4280 kJ/min
Work = 15 kW = 900 kJ/min
C.O.P. = Refrigeration effect / Work
= 4280 / 900
= 4.75.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œCompound VCR System â€“ Cascade Systems â€“ 1â€�.

1. Why is the cascade system used?
a) To attain low C.O.P.
b) To decrease the refrigeration effect
c) To produce low temperatures
d) To increase leakage loss

Answer: c
Explanation: If the vapor compression system is to be used for the production of temperatures, the common choice to stage type compression is a cascade system.

2. What is Cryogenics?
a) C.O.P. reduction
b) Low-temperature refrigeration
c) Work enhancement
d) High-temperature refrigeration

Answer: b
Explanation: Cryogenics means low-temperature refrigeration. It is applied to very low-temperature refrigeration applications. This word is derived Greek word Cryos meaning cold or frost.

3. What is the principal advantage of the cascade system?
a) Increase of work done
b) Decrease the refrigeration effect

c) Use of only one refrigerant
d) Use of multiple refrigerants

Answer: d
Explanation: Multiple refrigerants can be used in this type of system. It helps to attain lower temperatures, and the refrigeration effect can be enormously increased.

4. How is a cascade system structured?
a) VCR system in parallel combination
b) VCR system is not used
c) VCR system in a series combination
d) VAR system is used

Answer: c
Explanation: The cascade refrigeration system is structured by connecting two or more vapor compression refrigeration systems in series which use different refrigerants.

5. Low-temperature cascade system use refrigerants with ______ boiling temperature and high temperature cascade system use refrigerants with _________ boiling temperature.
a) low, high
b) high, low
c) low, low
d) high, high

Answer: a
Explanation: The high-temperature cascade system uses a refrigerant with high boiling temperatures such as R-12 or R-22. The low-temperature cascade system uses a refrigerant with low boiling temperatures such as R-13 or R-13 BI. This is used to achieve a higher coefficient of performance by increasing the refrigeration effect.

6. What does low boiling refrigerants ensure?
a) Lower C.O.P.
b) Higher C.O.P.
c) Lower pressure
d) Larger compressor displacement

Answer: b
Explanation: Low boiling temperature refrigerant has extremely high pressure. Due to this smaller compressor displacement is ensured. So, smaller displacement decreases overall work and increases the C.O.P. of the system.

7. Which intermediate refrigerants were used for the first time in the cascade system?
a) CO_2 and CO
b) CO and SO_2
c) NH_3 and CO_2
d) CO_2 and SO_2

Answer: d
Explanation: Firstly, the cascade system was used by Pietet in 1877. Cascade system was used for the liquefaction of oxygen using the Sulphur dioxide (SO_2) and Carbon dioxide (CO_2) as intermediate refrigerants.

8. The difference between low-temperature cascade condenser temperature and high-temperature cascade evaporator temperature is called temperature ______
a) subtraction
b) overview
c) overlap
d) gradient

Answer: c
Explanation: Temperature overlap is the difference between low-temperature cascade condenser temperature and high-temperature cascade evaporator temperature. Temperature overlap is a crucial phenomenon to attain higher C.O.P. because it shows the heat transfer in the system.

9. What is Intermediate temperature?
a) Temperature overlap is zero
b) Temperature overlap is infinity
c) The temperature of the low-temperature cascade system
d) The temperature of the high-temperature cascade system

Answer: a
Explanation: Intermediate temperature is achieved when the temperature overlap is zero i.e., the difference between low-temperature cascade condenser temperature and high-temperature cascade evaporator temperature is zero. Intermediate temperature indicates that both temperatures are equal. Intermediate temperature affects the heat transfer in the system.

This set of Refrigeration Questions and Answers for Entrance exams focuses on â€œTwo/Multi Stage Compression with Water Intercooling, Liquid Subcooling and Flash Chamber â€“ 2â€�.

1. Why is multi-stage or compound VCR with water intercooler, liquid sub-cooler, and the flash chamber used?
a) To improve C.O.P.
b) To decrease the refrigeration effect
c) To increase work
d) To increase leakage loss

Answer: a
Explanation: By de-superheating or intercooling the refrigerant before the second stage compression but not till the saturated vapor line, can decrease the total work required. By using the liquid sub-cooler, subcooling is done, and an increase in the refrigeration effect is achieved. Use of flash chamber ensures the saturated vapor form of refrigerant being entered into the second stage, which also helps reduce the work. So, the increase in R.E. and decrease in work improves the C.O.P. of the system.

2. What is the purpose of using intercooler?
a) To increase the cost of the compressor
b) To cool the superheated refrigerant
c) To re-heat superheated refrigerant
d) To reduce the volumetric efficiency

Answer: b
Explanation: Intercooler is used to cool the superheated refrigerant by some amount but in this case, not till the saturated vapor line. The superheated refrigerant leaving the first compressor is cooled by suitable method before entering the second compressor. This type of cooling is known as intercooling.

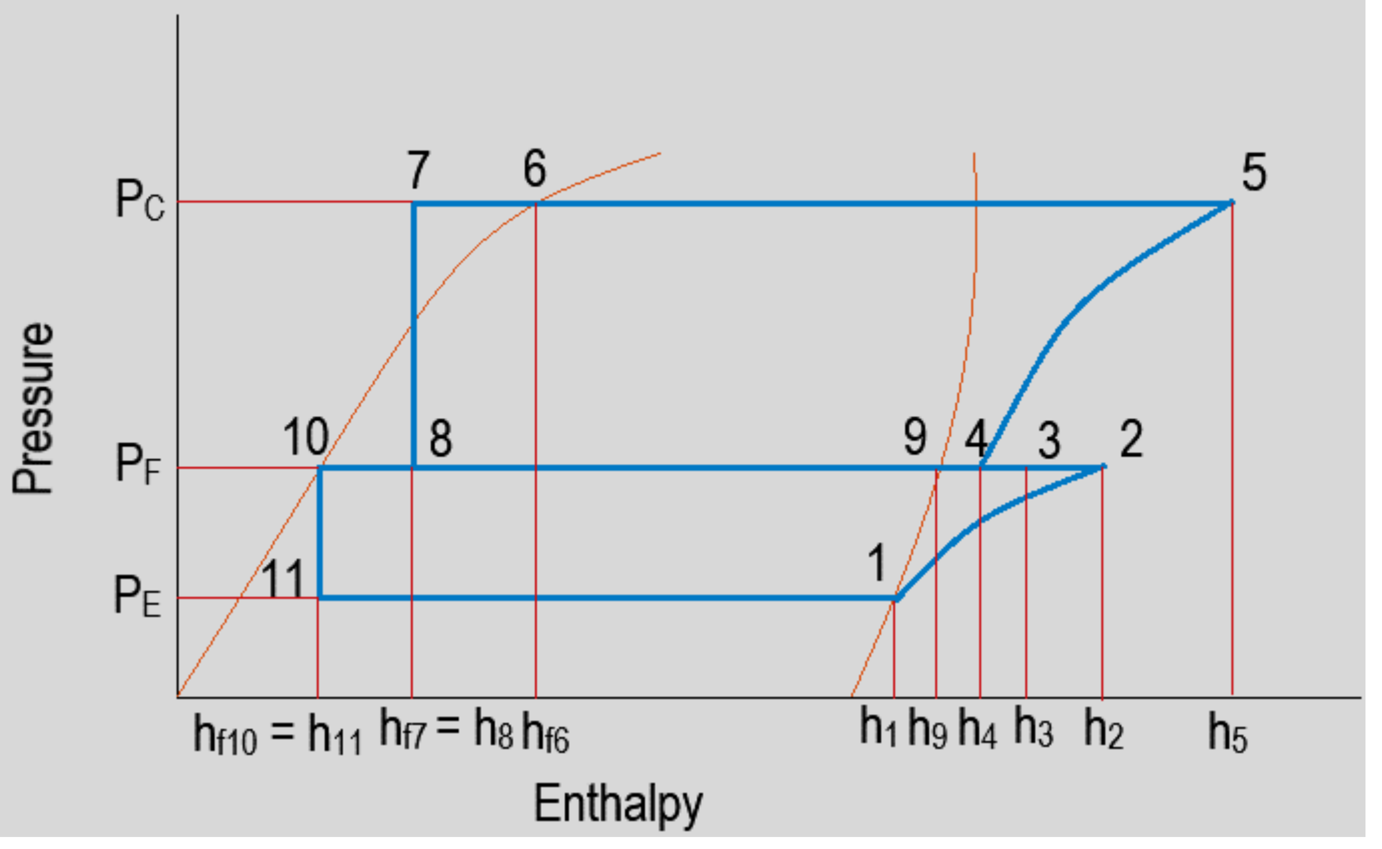
3. What is the purpose of using liquid sub-cooler?
a) To increase the cost of the compressor
b) To reduce the volumetric efficiency
c) To re-heat superheated refrigerant
d) To increase the refrigeration effect

Answer: d
Explanation: Liquid sub-cooler is used to sub-cool the liquid refrigerant coming from the condenser beyond the saturated liquid line. Sub-cooling results in an increase in refrigeration effect and thus increasing the C.O.P.

4. What is the purpose of using a flash chamber?
a) To increase pressure
b) To decrease pressure
c) To separate vapor and liquid refrigerant
d) To evaporate refrigerant partially

Answer: c
Explanation: Flash chamber is used to separate vapor and liquid refrigerant. It is an insulated container and separates both forms by using the centrifugal effect.

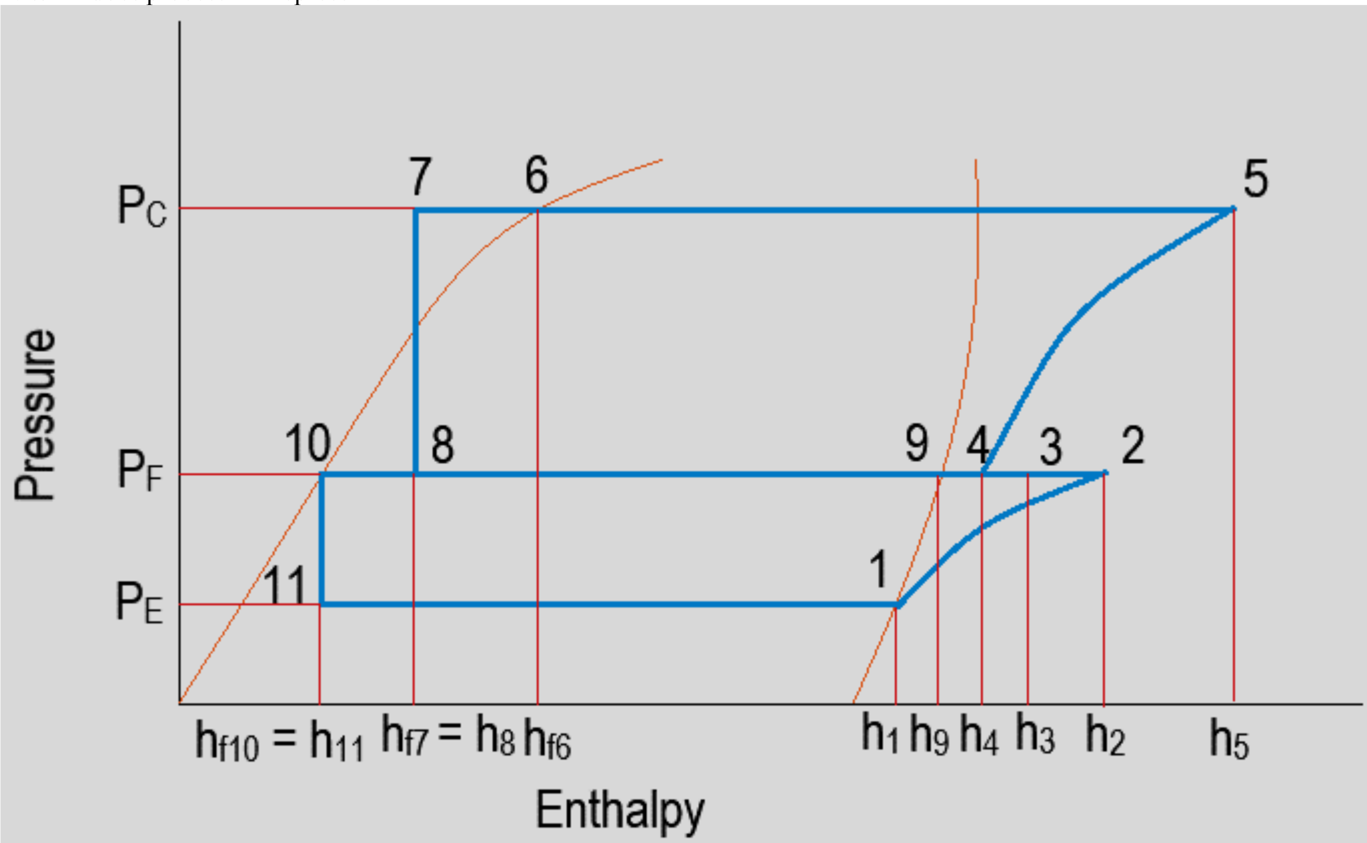
5. What does process 1-2 and 4-5 represent?



a) Evaporation
b) Compression
c) Condensation
d) Expansion

Answer: b
Explanation: Process 1-2 and 4-5 represent compression. This type of compression is isentropic compression, which is carried out in two stages. The first compression is carried out in low-pressure compressor and then compressed in the high-pressure compressor.

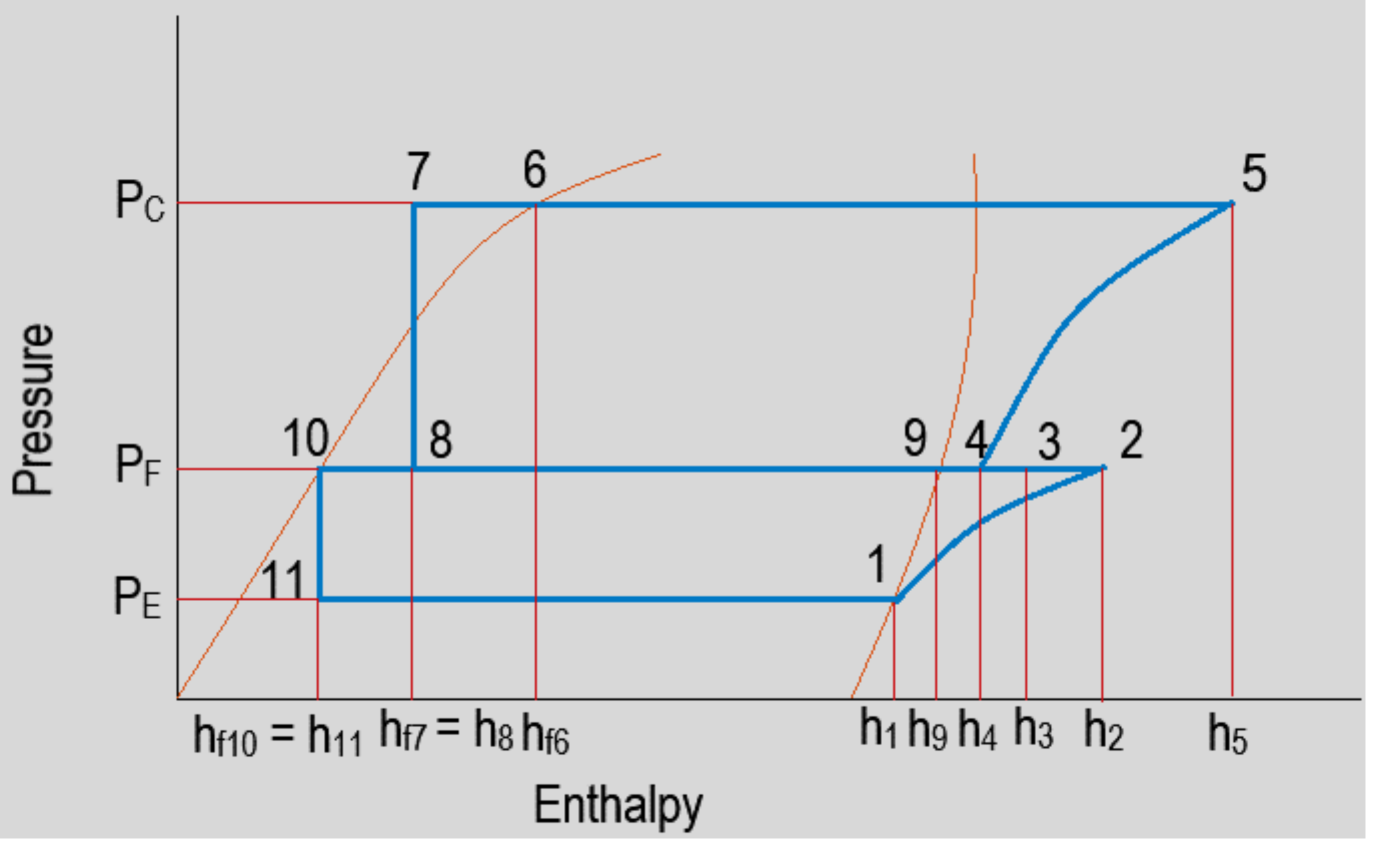
6. What does process 2-3 represent?



a) Evaporation
b) Compression
c) Intercooling
d) Condensation

Answer: c
Explanation: Process 2-3 represent intercooling or de-superheating. Intercooling is carried out to some extent but not till the saturated vapor line before the second stage of compression. Intercooling results in effective compression in the high-pressure compressor resulting in the reduction of the overall work done.

7. What do P_C, P_E, and P_F represent?

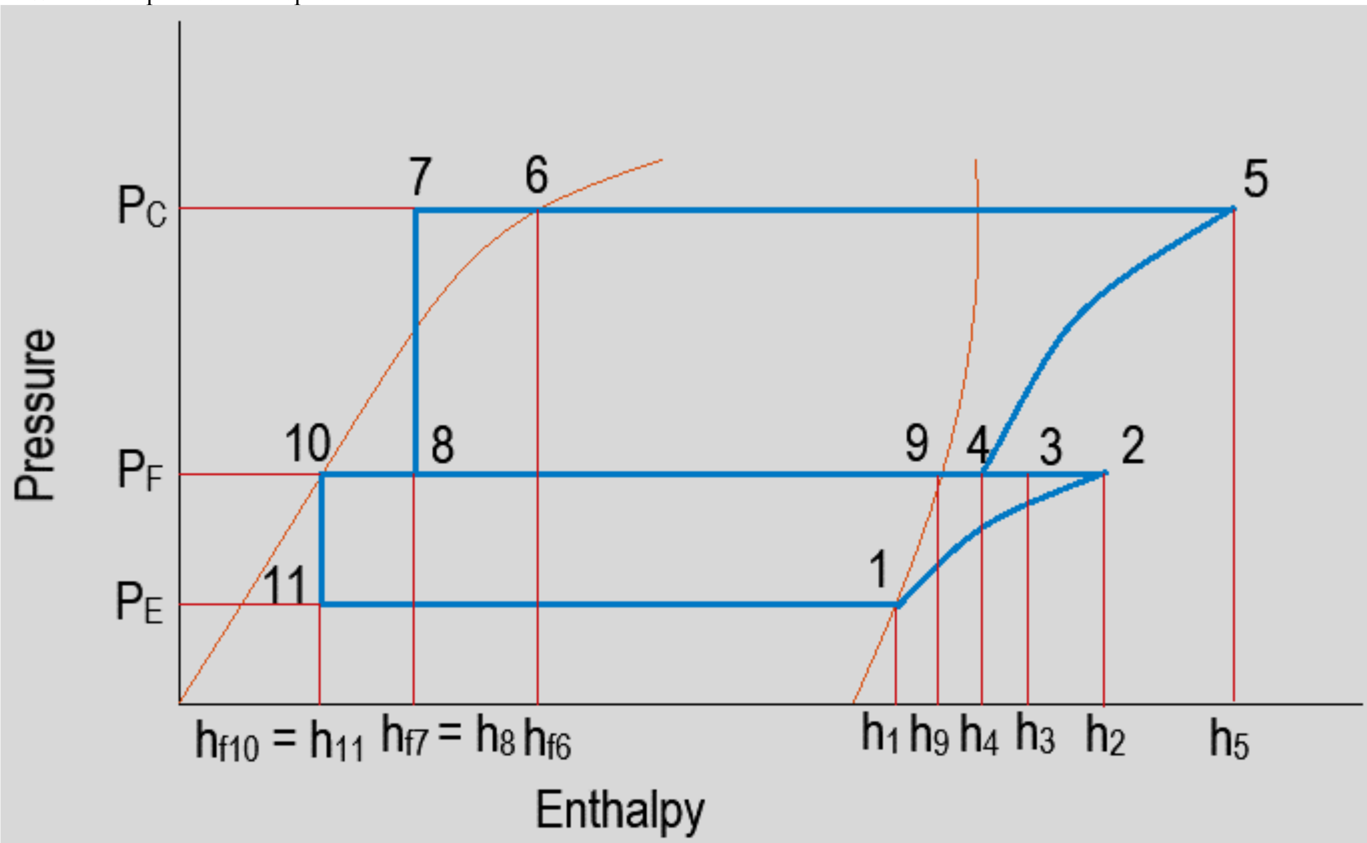


a) Evaporator, expansion and flash chamber pressure
b) Compression, expansion and flash chamber pressure
c) Condenser, evaporator and flash chamber pressure
d) Intercooling pressure

Answer: c
Explanation: P_C is for condenser pressure. The pressure at which latent heat is rejected from the refrigerant and converting vapor form to liquid form. P_E is for evaporator pressure. The pressure at which latent heat of

vaporization is absorbed from the medium and phase change from liquid to vapor is carried out. P_F is for flash chamber pressure, the pressure at which liquid and vapor refrigerants are separated. Attaining and maintaining these pressures is essential for the smooth operation of the cycle.

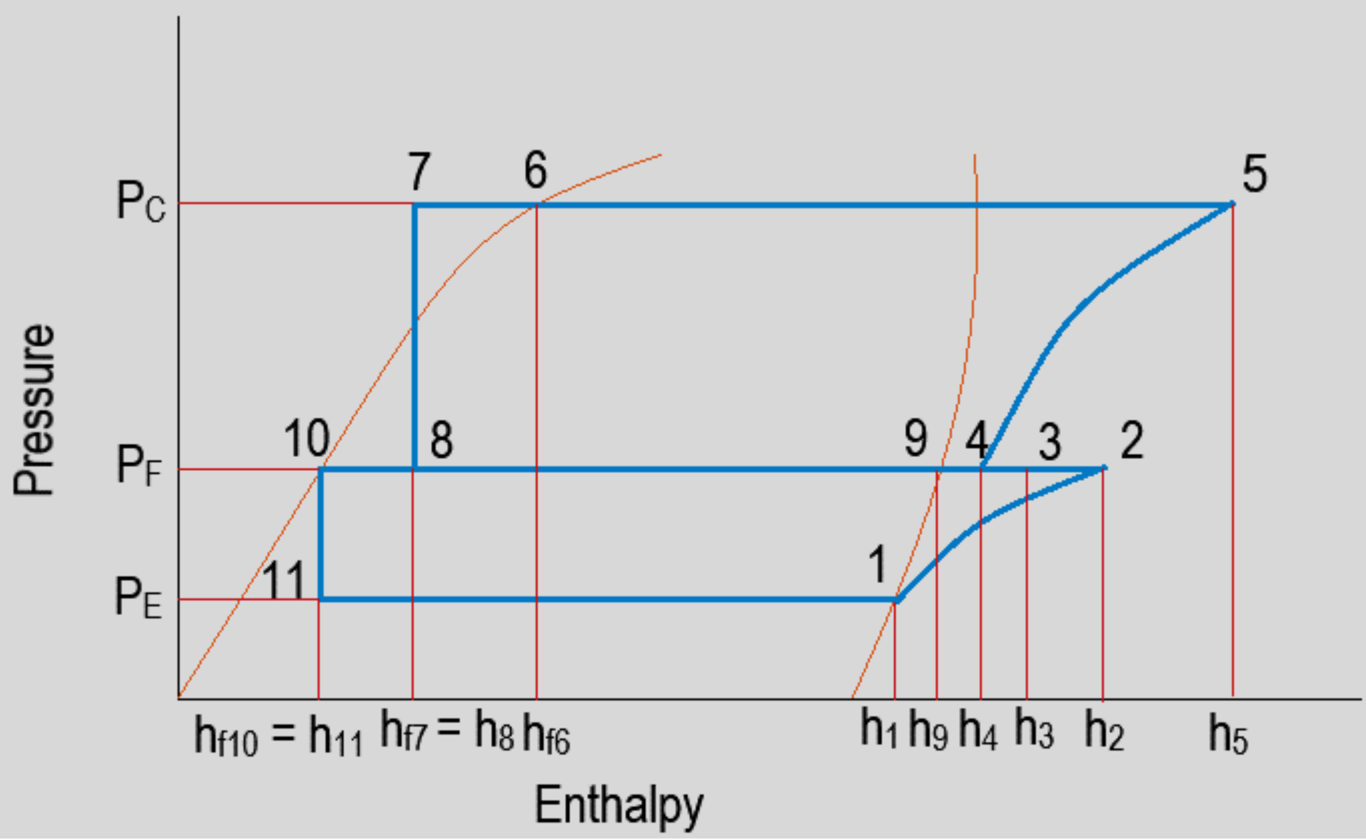
8. What does process 3-4 represent?



a) Evaporation
b) Compression
c) Mixing of refrigerant coming from the flash chamber
d) Condensation

Answer: c
Explanation: Process 3-4 represent the mixing of refrigerant coming from the flash chamber where intercooling or de-superheating happens. The separated vapor from the flash chamber comes in contact with vapor discharging from first stage compression. This mixture then enters second stage compression in a pure dry saturated state. This results in effective compression in the high-pressure compressor resulting in the reduction of the overall work done.

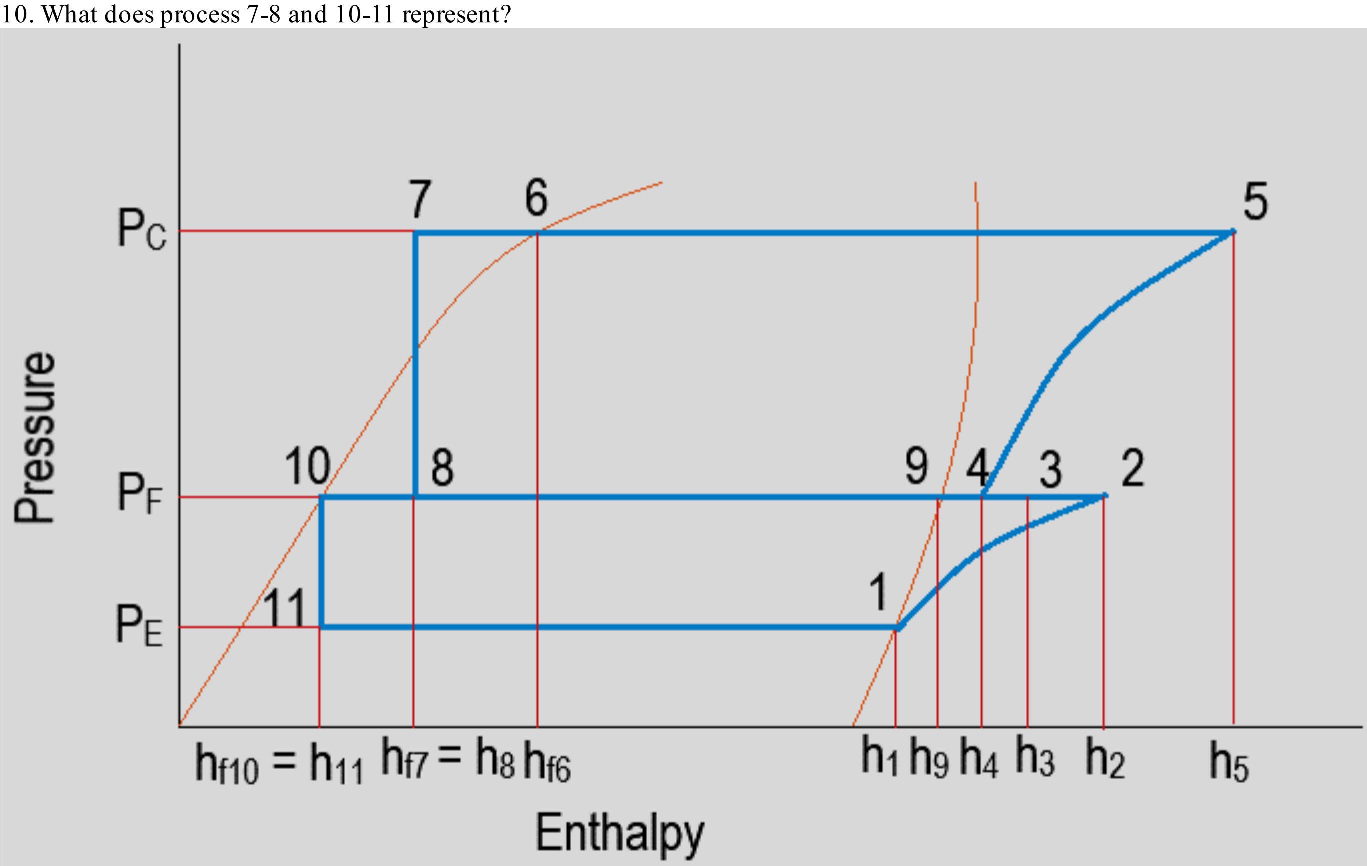
9. What does process 6-7 represent?



a) Evaporation
b) Compression
c) Mixing of refrigerant coming from the flash chamber
d) Sub-cooling

Answer: d
Explanation: Process 6-7 represent sub-cooling. The liquid refrigerant coming from the condenser is cooled further by the circulation of colder water to increase the refrigeration effect and to improve the C.O.P. of the system.

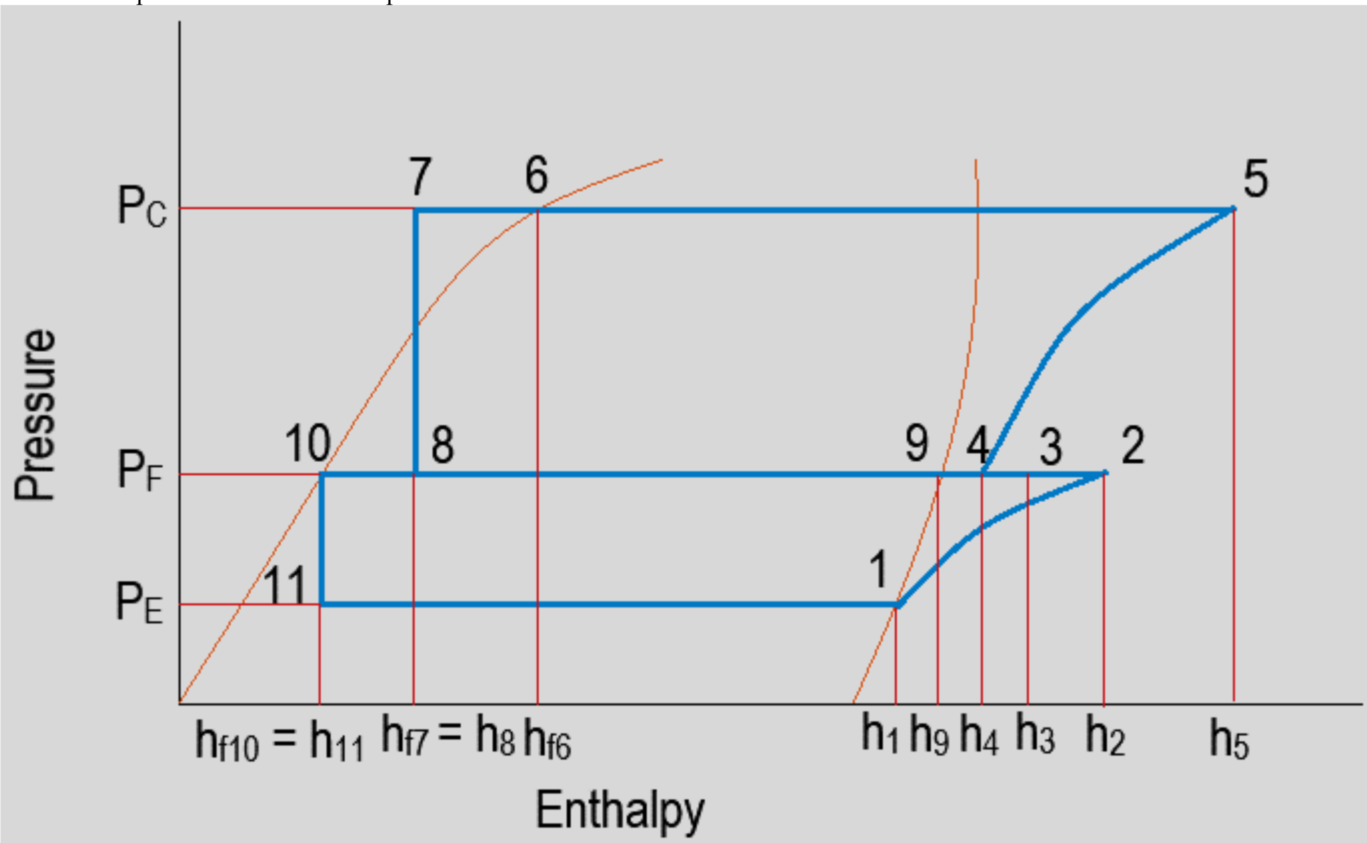
10. What does process 7-8 and 10-11 represent?



a) Expansion
b) Compression
c) Mixing of refrigerant coming from the flash chamber
d) Sub-cooling

Answer: a
Explanation: Process 7-8 and 10-11 represent expansion process. The subcooled liquid is expanded in the first expansion valve. Then after the separation of refrigerant in the flash chamber, it is passed through the second expansion valve to do the expansion process.

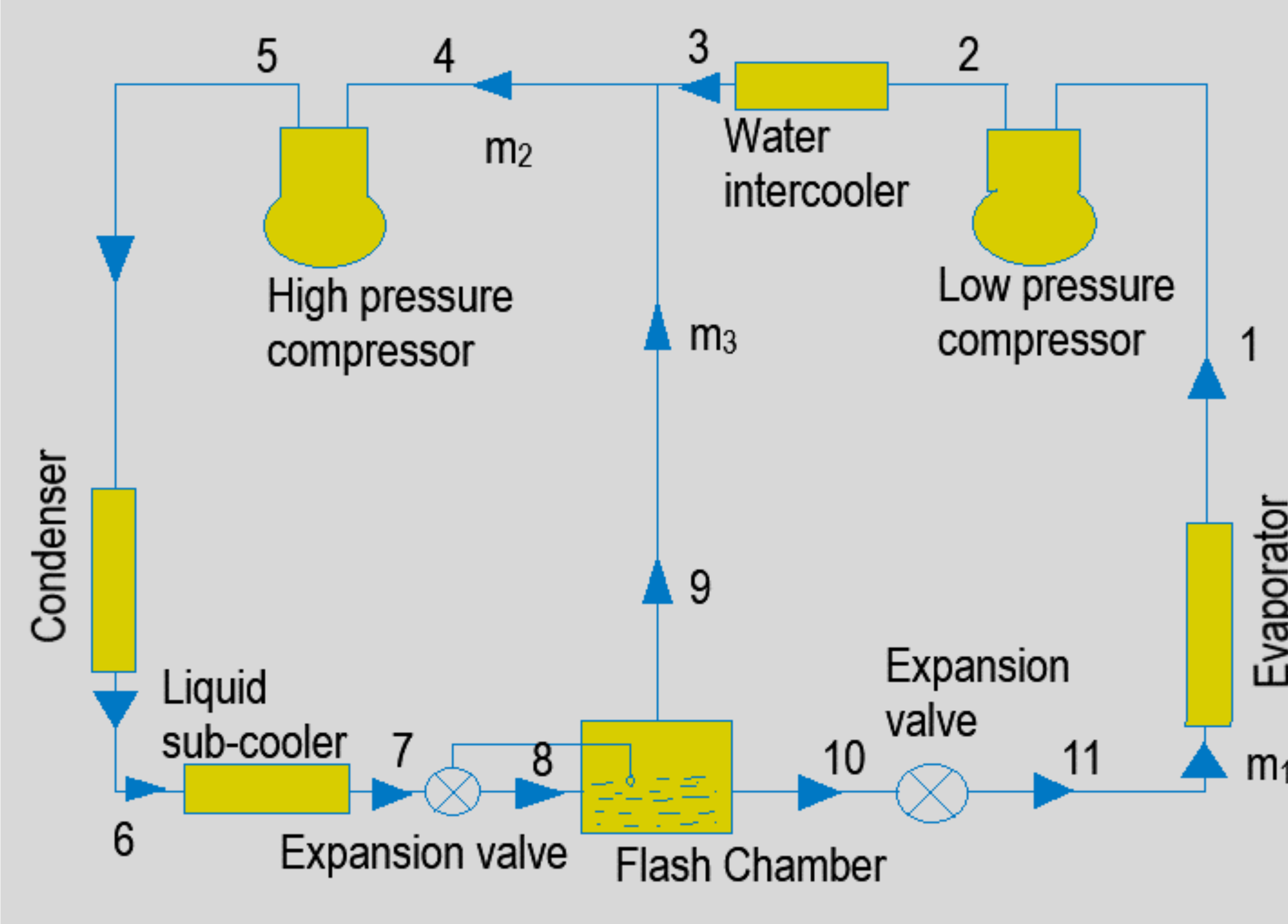
11. What do process 8-9 and 8-10 represent?

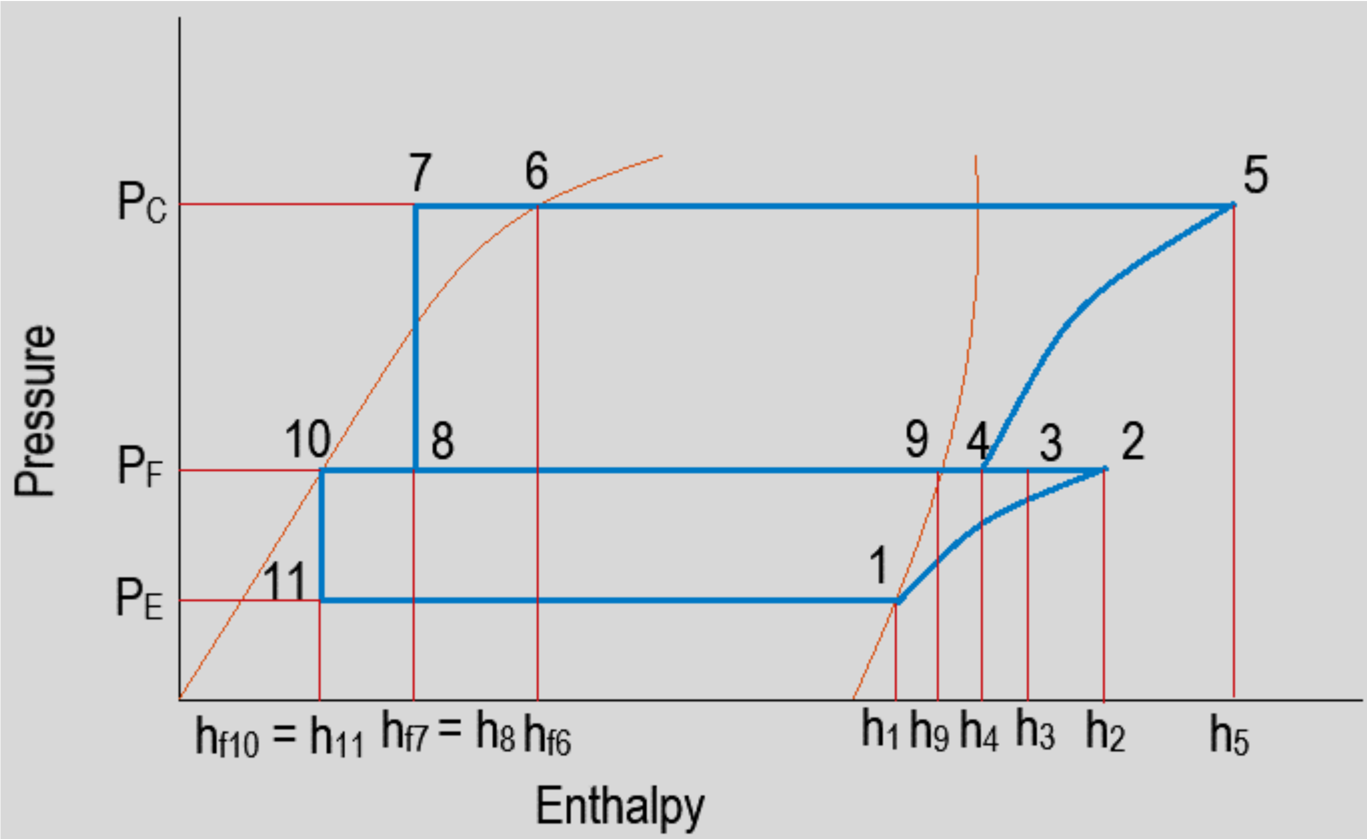


a) Expansion
b) Separating the vapor and liquid form of refrigerant
c) Compression
d) Sub-cooling

Answer: b
Explanation: Process 8-9 and 8-10 represent separating the liquid and vapor form of refrigerant. Process 8-9 ensures vapor refrigerant is transferred to the second stage of the compressor. Separates the pure dry saturated vapor and discharges to the vapor coming out of first stage compression. Process 8-10 ensures the saturated liquid is sent to the second expansion valve. The refrigerant reaches a saturated liquid line and then it is expanded.

12. What is the ratio of m_3 / m_2 for the following arrangement?

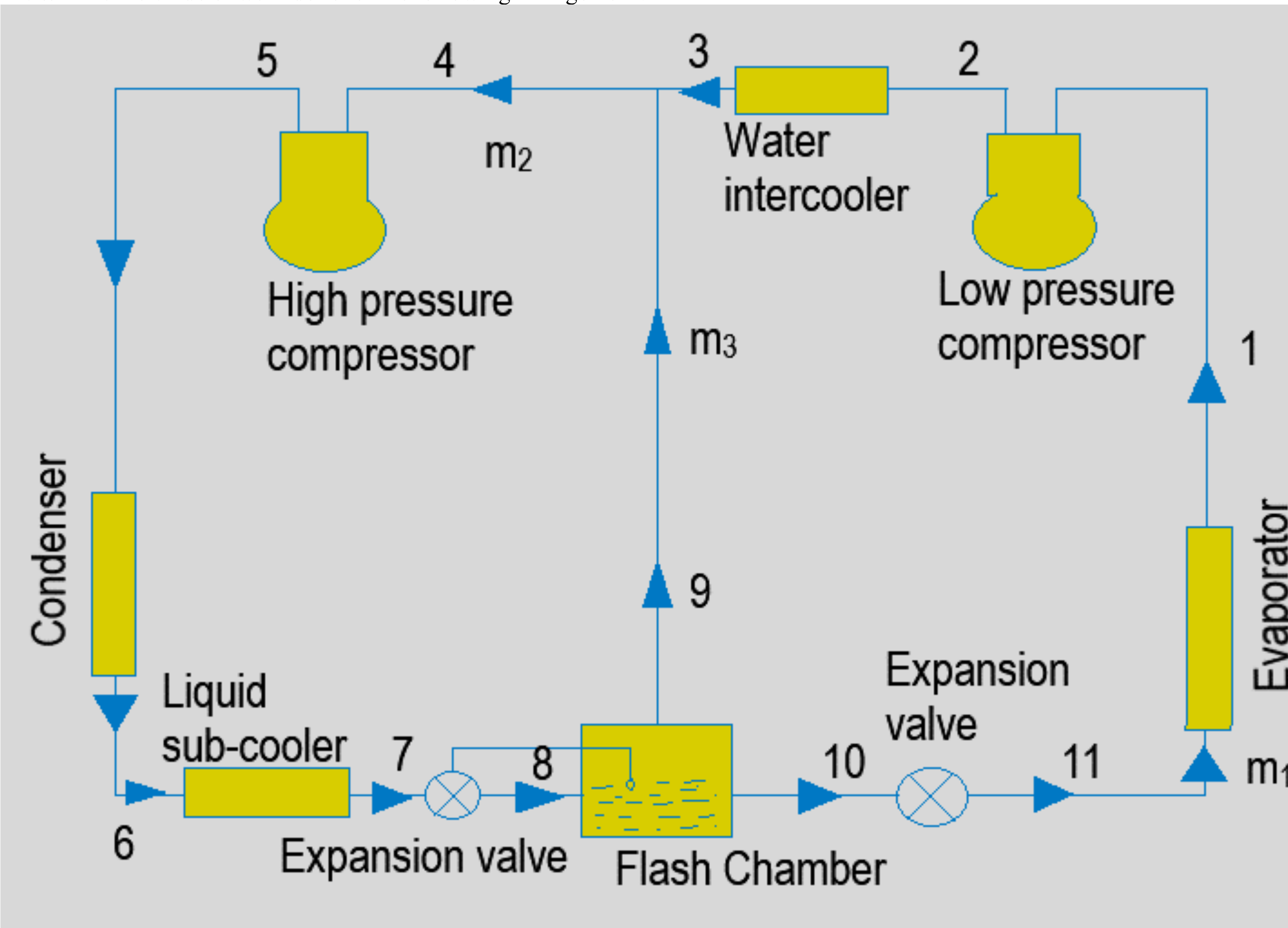


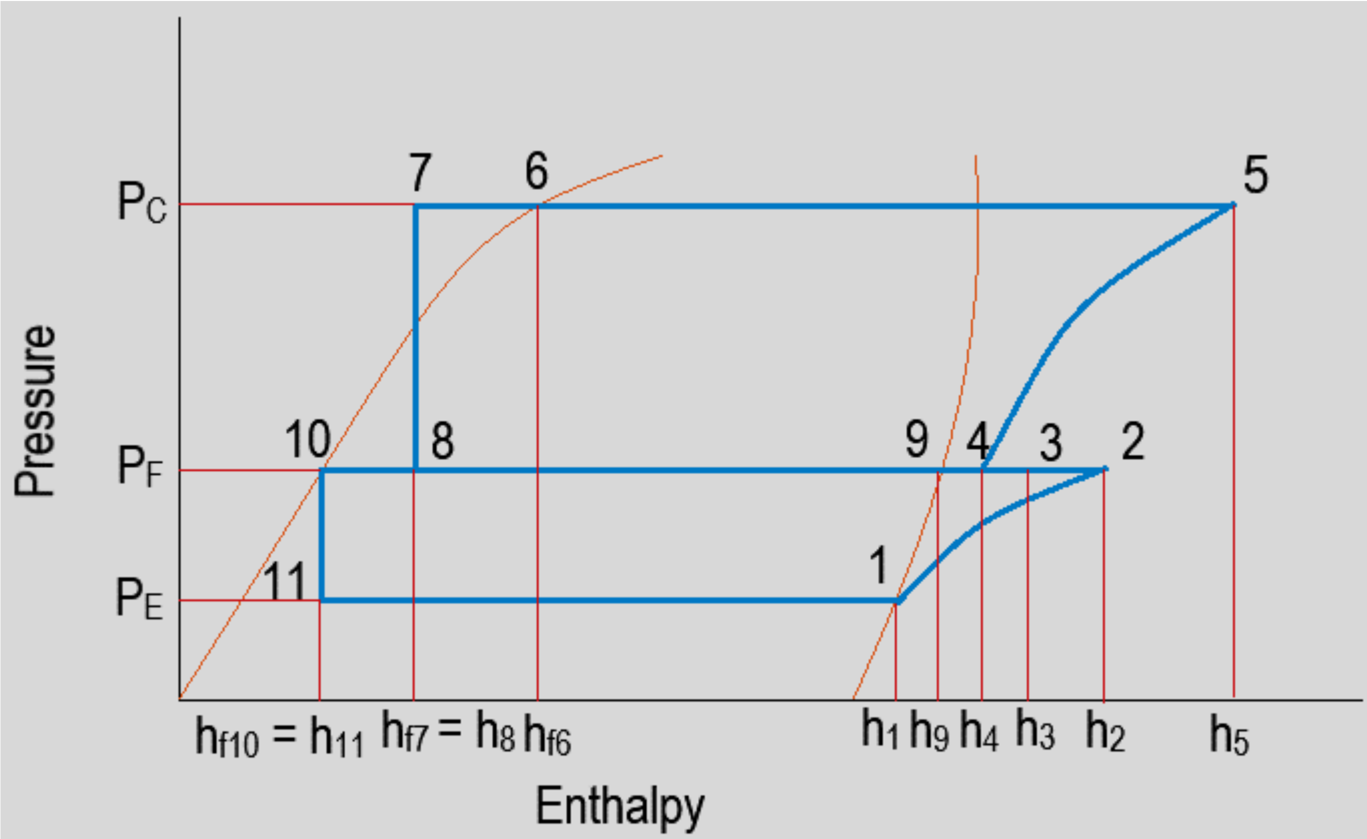


If, m_1 = Mass of refrigerant passing through the evaporator
m_2 = Mass of refrigerant passing through condenser
m_3 = Mass of vapor refrigerant formed in the flash chamber
a) (h_1 â€“ h_{f6}) / (h_2 â€“ h_1) â€“ (h_4 â€“ h_3)
b) (h_1 â€“ h_{f6}) / (h_2 â€“ h_1) + (h_4 â€“ h_3)
c) (h_8 â€“ h_{f10}) / (h_9 â€“ h_{f10})
d) (h_1 â€“ h_{f10}) / (h_4 â€“ h_9)

Answer: c
Explanation: Flash chamber is an insulated vessel. Hence, there is no heat exchange between flash chamber and surrounding. Considering the thermal equilibrium,
Heat taken by the flash chamber = Heat given by the flash chamber
$m_2 h_8 = m_3 h_9 + m_1 h_{f10}$
as, $m_1 = m_2$ â€“ m_3
$m_2 h_8 = m_3 h_9 + (m_2$ â€“ $m_3) h_{f10}$
$m_3 (h_9$ â€“ $h_{f10}) = m_2 (h_8$ â€“ $h_{f10})$
$m_3 / m_2 = (h_8$ â€“ $h_{f10}) / (h_9$ â€“ $h_{f10})$.

13. What is the value of work done for the following arrangement?

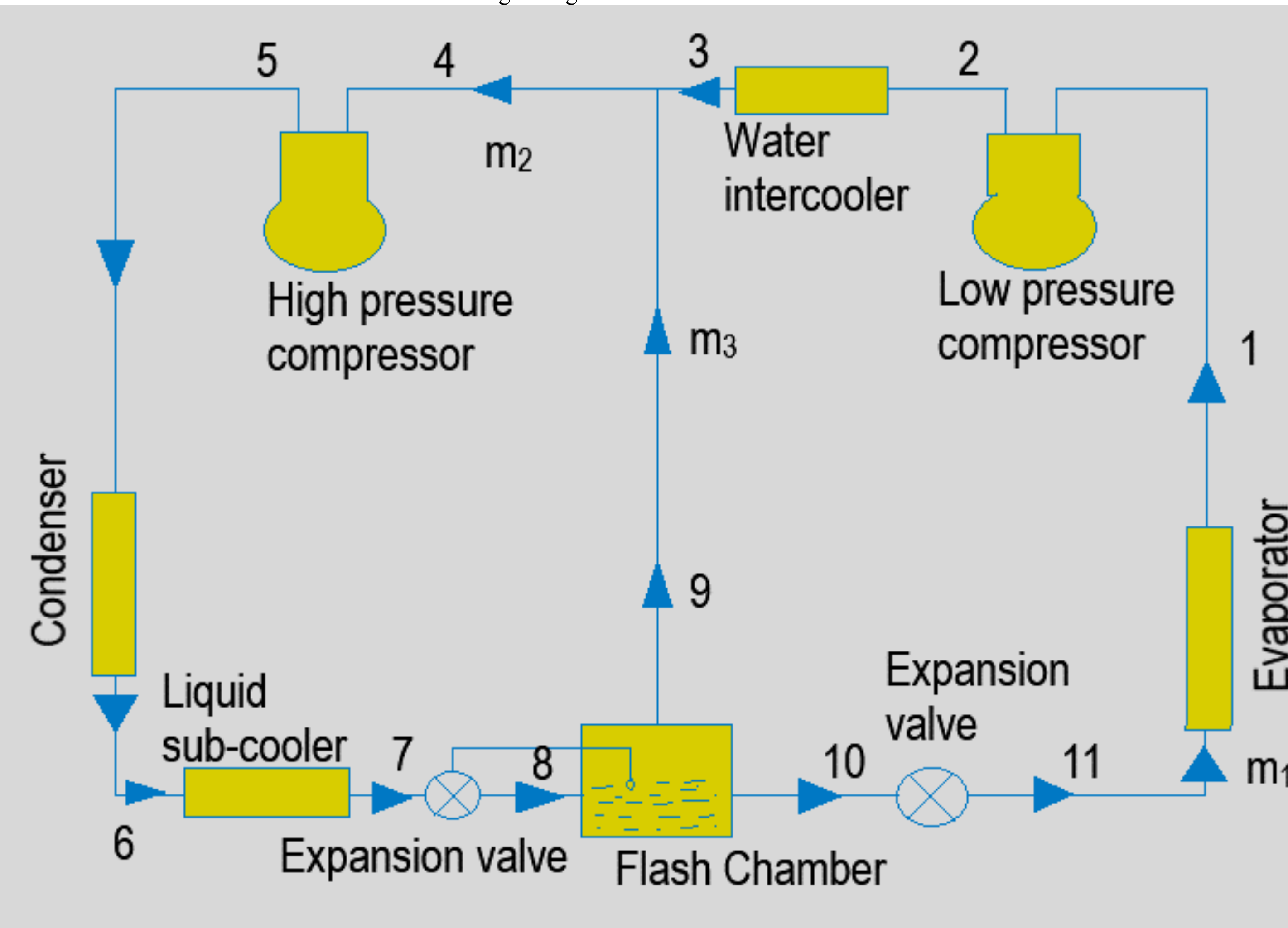


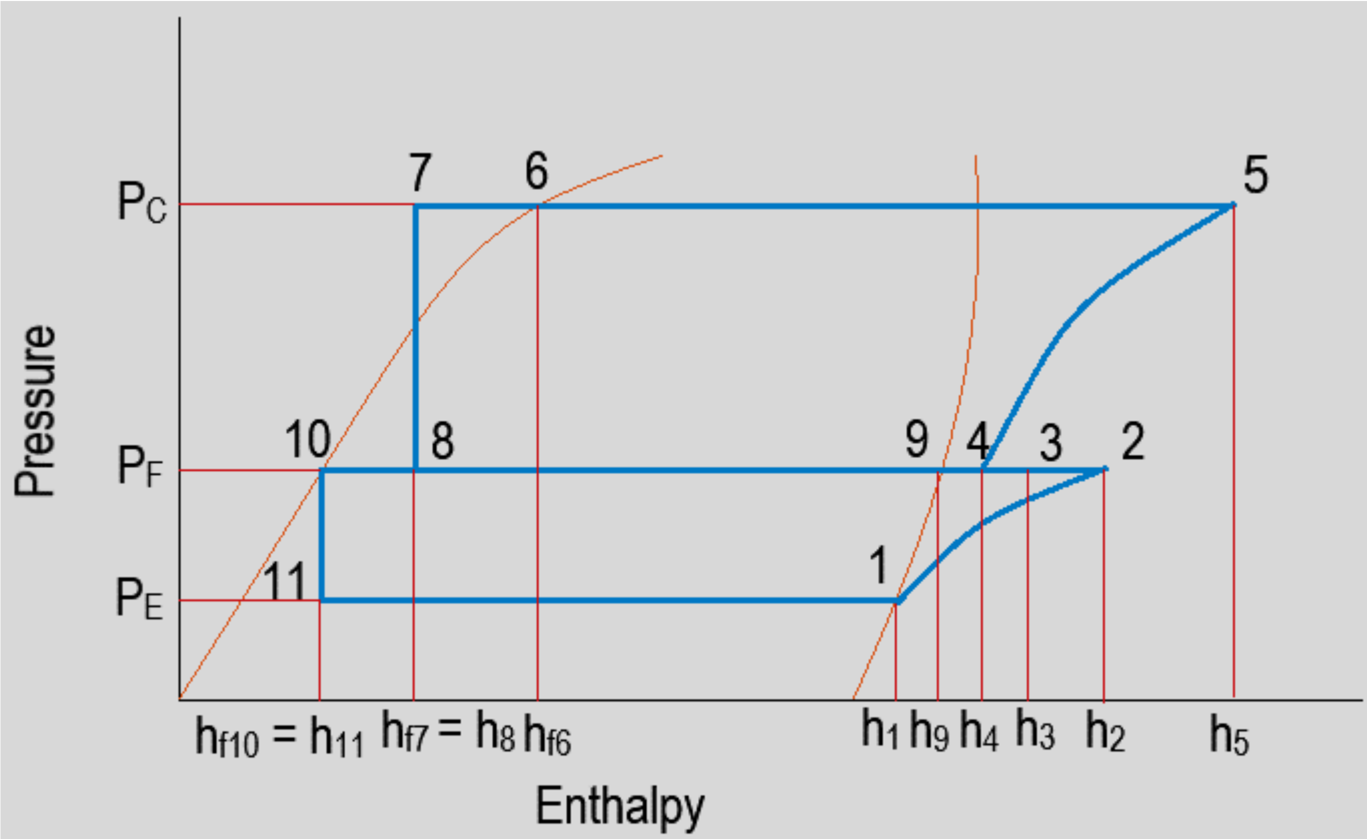


If, m_1 = Mass of refrigerant passing through the evaporator
m_2 = Mass of refrigerant passing through condenser
m_3 = Mass of vapor refrigerant formed in the flash chamber
a) m_1 (h_2 â€“ h_1) + m_2 (h_4 â€“ h_3)
b) m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4)
c) (h_8 â€“ h_{f10}) / (h_9 â€“ h_{f10})
d) (h_1 â€“ h_{f10}) / (h_4 â€“ h_9)

Answer: b
Explanation: By taking the help of above diagrams,
Work = Work done by low-pressure compressor + Work done by high-pressure compressor
= mass of refrigerant flowing through the low-pressure compressor x enthalpy change + mass of refrigerant flowing through the high-pressure compressor x enthalpy change
Work done by the low-pressure compressor = m_1 (h_2 â€“ h_1)
Work done by the high-pressure compressor = m_2 (h_5 â€“ h_4)
Total work = m_1 (h_2 â€“ h_1) + m_2 (h_5 â€“ h_4).

14. What is the value of work done for the following arrangement?





If, m_1 = Mass of refrigerant passing through the evaporator
m_2 = Mass of refrigerant passing through condenser
m_3 = Mass of vapor refrigerant formed in the flash chamber
a) $m_1 (h_1$ â€“ $h_{11}) / m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3)$
b) $m_3 (h_1$ â€“ $h_{f10}) / m_2 (h_4$ â€“ $h_9)$
c) $m_2 (h_8$ â€“ $h_{f10}) / m_1 (h_9$ â€“ $h_{f10})$
d) $m_1 (h_1$ â€“ $h_{11}) / m_1 (h_2$ â€“ $h_1) + m_2 (h_5$ â€“ $h_4)$

Answer: d
Explanation: As, C.O.P. = Refrigeration effect / Total work
Hence, by taking the help of above diagrams,
R.E. = Heat absorbed in the evaporator
= mass flowing through the evaporator x enthalpy change
= $m_1 (h_1$ â€“ $h_{11})$ as, $h_{f10} = h_{11}$
Work = Work done by low-pressure compressor + Work done by high-pressure compressor
= mass of refrigerant flowing through the low-pressure compressor x enthalpy change + mass of refrigerant flowing through the high-pressure compressor x enthalpy change
Total Work = $m_1 (h_2$ â€“ $h_1) + m_2 (h_5$ â€“ $h_4)$
Hence, C.O.P. = $m_1 (h_1$ â€“ $h_{11})$ / Total work
= $m_1 (h_1$ â€“ $h_{11}) / m_1 (h_2$ â€“ $h_1) + m_2 (h_5$ â€“ $h_4)$.

This set of Refrigeration Interview Questions and Answers for Experienced people focuses on â€œPerformance Characteristics of Refrigerant Reciprocating Compressorâ€�.

1. The performance of a refrigerant reciprocating compressor is not measured in terms of its _______________
a) refrigerating capacity
b) brake power per tonne of refrigeration
c) total brake power
d) horse power

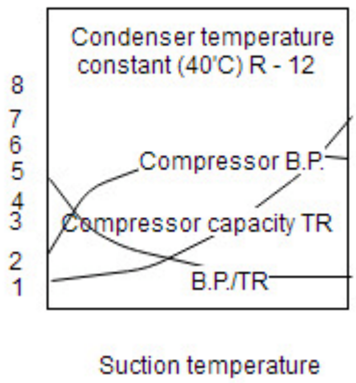
Answer: d
Explanation: The performance of a refrigerant reciprocating compressor is not measured in terms of its refrigerating capacity, brake power per tonne of refrigeration and total brake power.

2. Which one of the following is not an important parameter in the design of a refrigerant reciprocating compressor?
a) Evaporator temperature
b) Condenser temperature
c) Suction temperature
d) Compressor temperature

Answer: d
Explanation: The important parameters in the design of a refrigerant reciprocating compressor are the evaporator or suction temperature and condenser temperatures.

3. The refrigeration capacity decreases with the decrease in the evaporator or suction temperature.
a) True
b) False

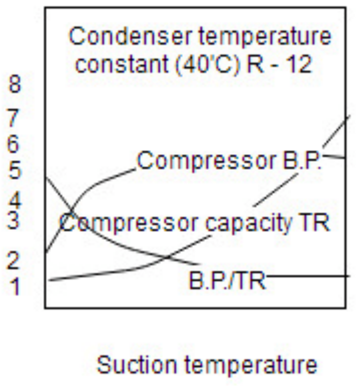
Answer: a
Explanation:



The refrigeration capacity decreases with the decrease in the evaporator or suction temperature. It is due to the fact that at low suction temperature, the vaporising pressure is low and therefore the density of suction vapor entering the compressor is low. Hence the mass of refrigerant circulated through the compressor per unit time decreases with the decrease in suction temperature for a given displacement.

4. The effect of suction temperature on the compressor B.P. per tonne of refrigeration is?
a) Compressor B.P. per tonne of refrigeration decreases with the increase in suction temperature
b) Compressor B.P. per tonne of refrigeration increases with the increase in suction temperature
c) Compressor B.P. per tonne of refrigeration remains the same with any change in suction temperature
d) Compressor B.P. per tonne of refrigeration decreases with the decrease in suction temperature

Answer: a
Explanation:

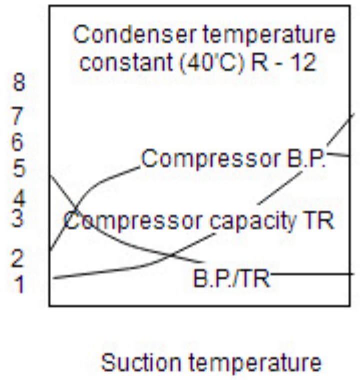


The effect of suction temperature on the compressor B.P. per tonne of refrigeration is that the compressor B.P. per tonne of refrigeration decreases with the increase in suction temperature, when the condenser temperature remains the same.

5. The effect of suction temperature on the total B.P. is?
a) To increase the B.P. with the decrease of suction temperature

b) To decrease the B.P. with the decrease of suction temperature
c) That the total B.P. remains unaffected by the changes in suction temperature
d) Canâ€™t say only from the suction temperature

Answer: b
Explanation:



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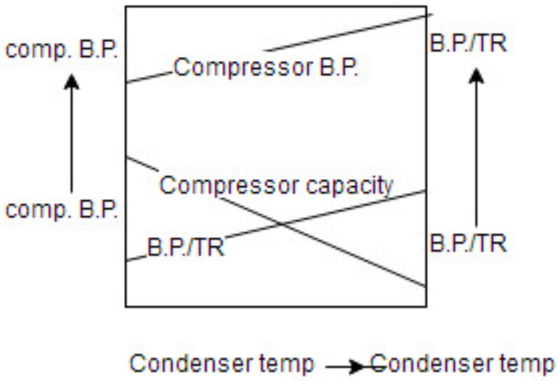
The total B.P. of the compressor is dependent on the work of compression and the mass of refrigerant circulated per minute. Hence the effect of suction temperature on the total B.P. is to increase the B.P. with the decrease of suction temperature.

6. What is the effect of condenser temperature on compressor refrigerating capacity?
a) Increase in temperature decreases the refrigeration capacity
b) Decrease in temperature decreases the refrigeration capacity
c) Does not affect the capacity of refrigeration
d) Increase in temperature increases the refrigeration capacity

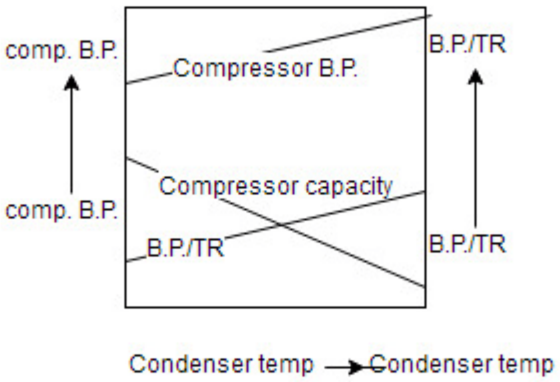
Answer: a
Explanation:



The effect of condenser temperature on compressor refrigerating capacity is to decreases the refrigeration capacity by increasing the condenser temperature.

7. What is the effect of condenser temperature on B.P. per tonne of refrigeration?
a) Increase in temperature decreases the B.P.
b) Decrease in temperature increases the B.P.
c) Does not affect the B.P.
d) Increase in temperature increases the B.P.

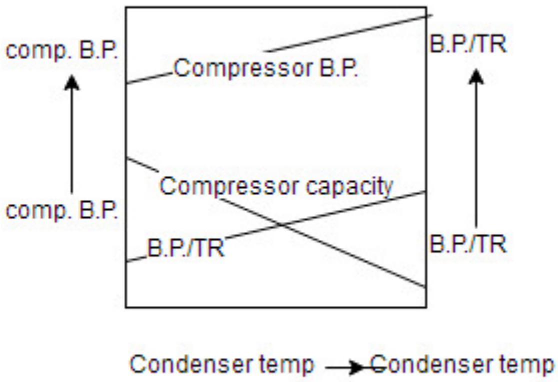
Answer: d
Explanation:



The effect of condenser temperature on B.P. per tonne of refrigeration is to increase the B.P. by increasing the condenser temperature.

8. What is the effect of condenser temperature on total B.P.?
a) Increase in temperature decreases the total B.P.
b) Decrease in temperature increases the total B.P.
c) Does not affect the total B.P.
d) Increase in temperature increases the total B.P.

Answer: d
Explanation:



The effect of condenser temperature on the total B.P. is to increase the total B.P. by increasing the condenser temperature.

This set of Refrigeration Questions and Answers for Campus interviews focuses on â€œCompound VCR System â€“ Cascade Systems â€“ 2â€�.

1. Multiple refrigerants can be used in the cascade refrigeration system.
a) True
b) False

Answer: a
Explanation: Multiple refrigerants can be used in the cascade refrigeration system. It helps to attain lower temperatures, and the refrigeration effect can be enormously increased.

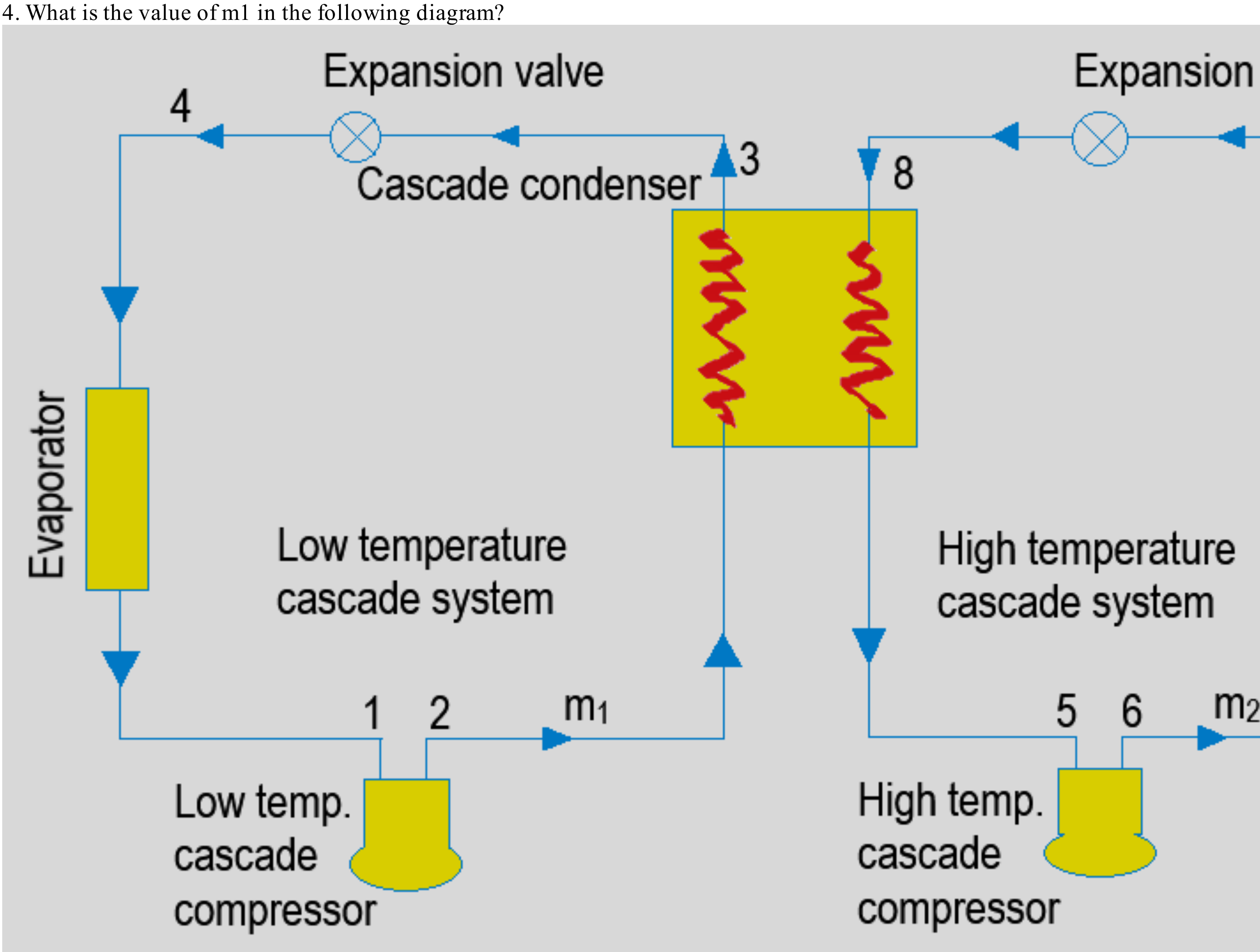
2. How is the cascade system achieved?
a) VCR system in a parallel combination
b) VAR system in a series combination
c) VAR system in a parallel combination
d) VCR system in a series combination

Answer: d
Explanation: The cascade refrigeration system is structured by connecting two or more vapor compression refrigeration systems in series which use different refrigerants.

3. Cascade refrigeration system reduces the C.O.P.
a) True
b) False

Answer: b
Explanation: Due to the usage of multiple refrigerants and temperature overlap phenomenon, the refrigeration effect is increased, and overall work is reduced, leading to enhance the C.O.P. of the system.

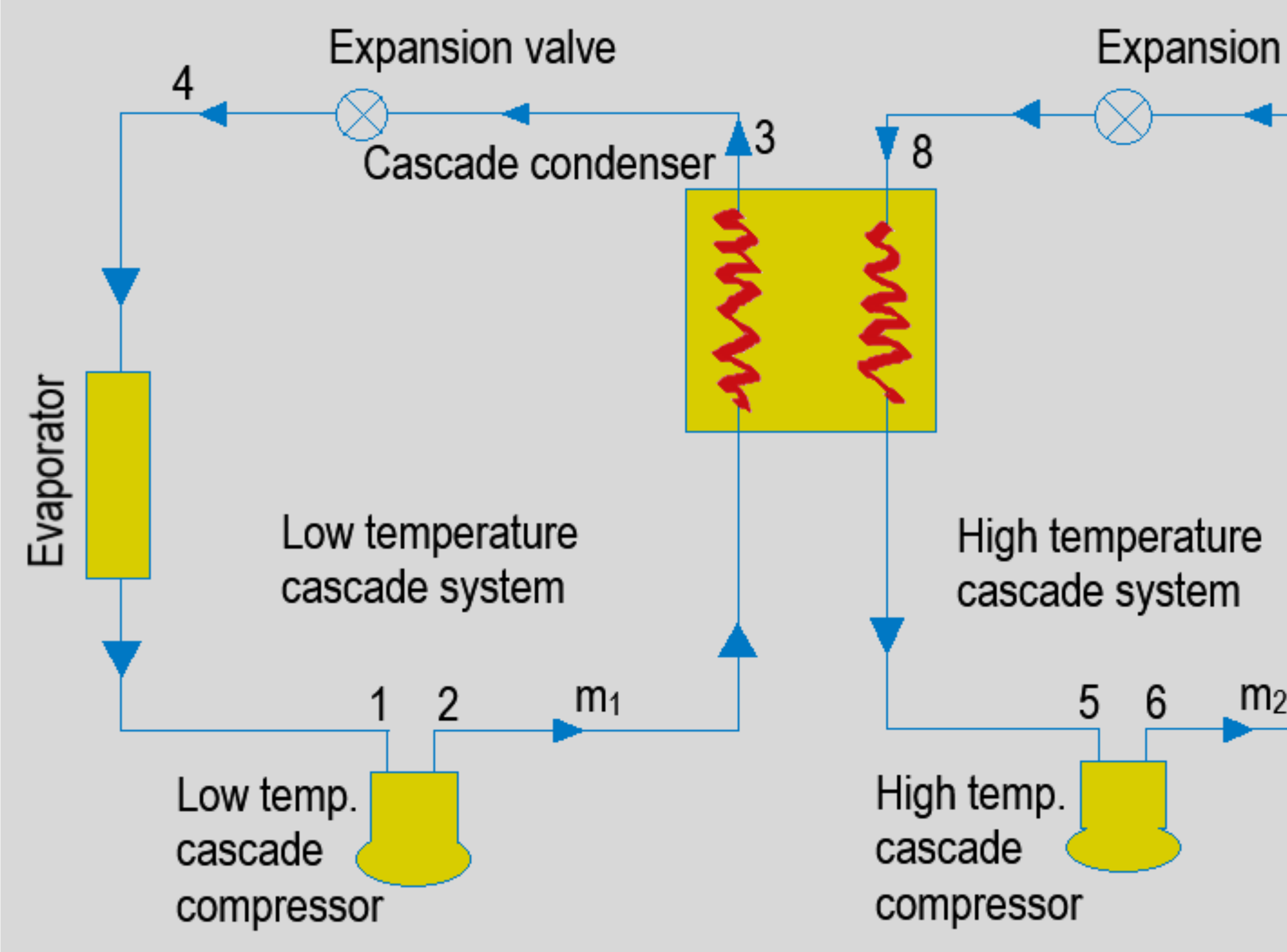
4. What is the value of m1 in the following diagram?



a) 210 Q / (h_1 â€“ h_7) kg/min
b) 210 Q / (h_1 â€“ h_4) kg/s
c) 210 Q / (h_1 â€“ h_4) kg/min
d) 210 Q / (h_1 â€“ h_7) kg/s

Answer: c
Explanation: As m_1 flows through the low-temperature cascade system. So, when it passes through the evaporator i.e., between point 1 and point 4, there is a change in enthalpy, which produces the refrigeration effect.
Hence, R.E. = m x delta h
210 Q = m_1 x (h_1 â€“ h_4)
m_1 = 210 Q / (h_1 â€“ h_1) kg/min.

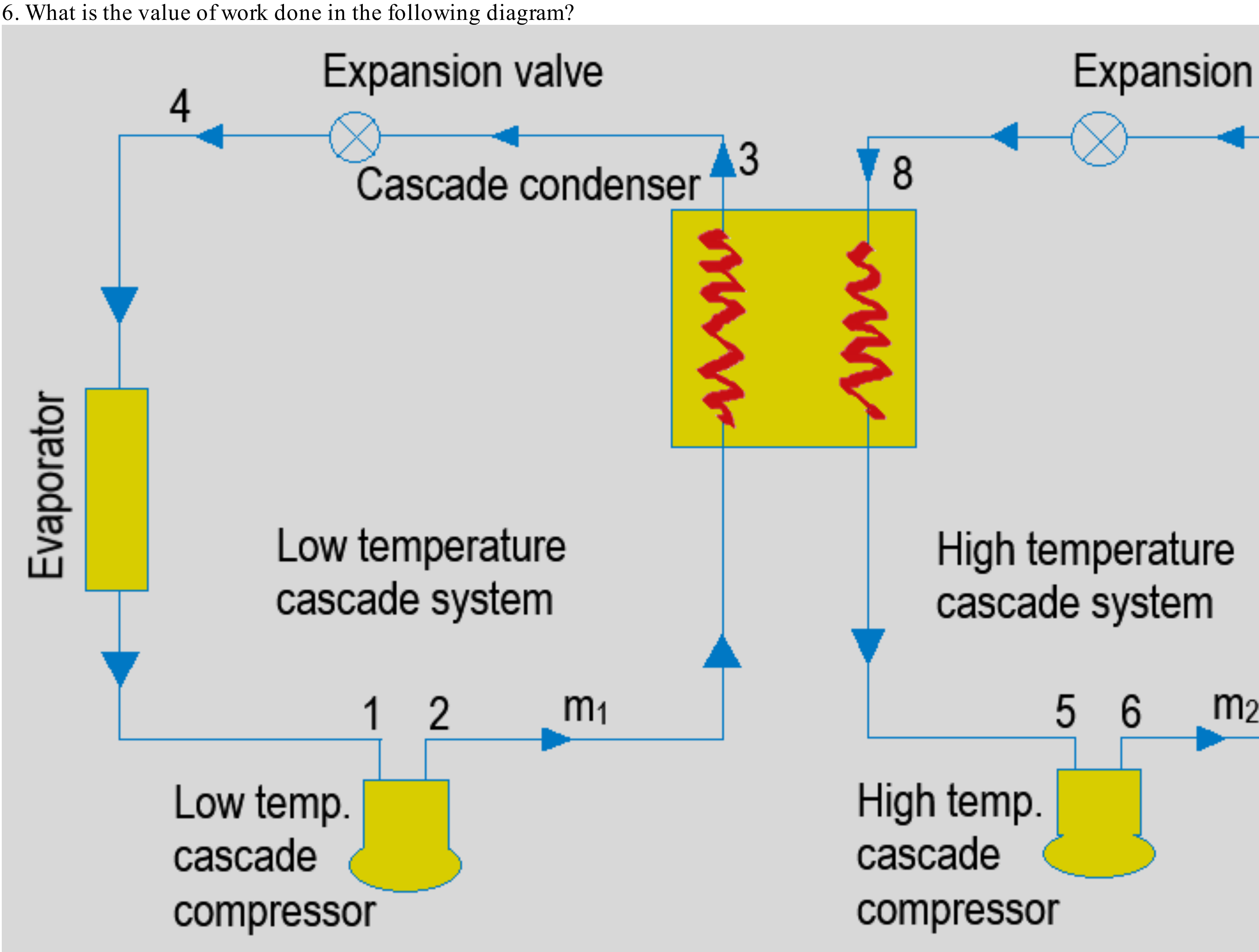
5. What is the value of m_2 / m_1 in the following diagram?



a) $(h_2$ â€“ $h_4) / (h_5$ â€“ $h_8)$
b) $(h_6$ â€“ $h_4) / (h_7$ â€“ $h_8)$
c) $(h_1$ â€“ $h_4) / (h_6$ â€“ $h_8)$
d) $(h_2$ â€“ $h_1) / (h_1$ â€“ $h_8)$

Answer: a
Explanation: The cascade condenser is an intermediate between low temperature and high temperature cascade system. The heat between both systems is balanced hence, taking the thermal equilibrium of condenser.
Heat absorbed in the high temperature cascade system = Heat rejected in the low temperature cascade system
$m_2 h_5 + m_1 h_4 = m_1 h_2 + m_2 h_8$
$m_1 (h_2$ â€“ $h_4) = m_2 (h_5$ â€“ $h_8)$
$m_2 / m_1 = (h_2$ â€“ $h_4) / (h_5$ â€“ $h_8)$.

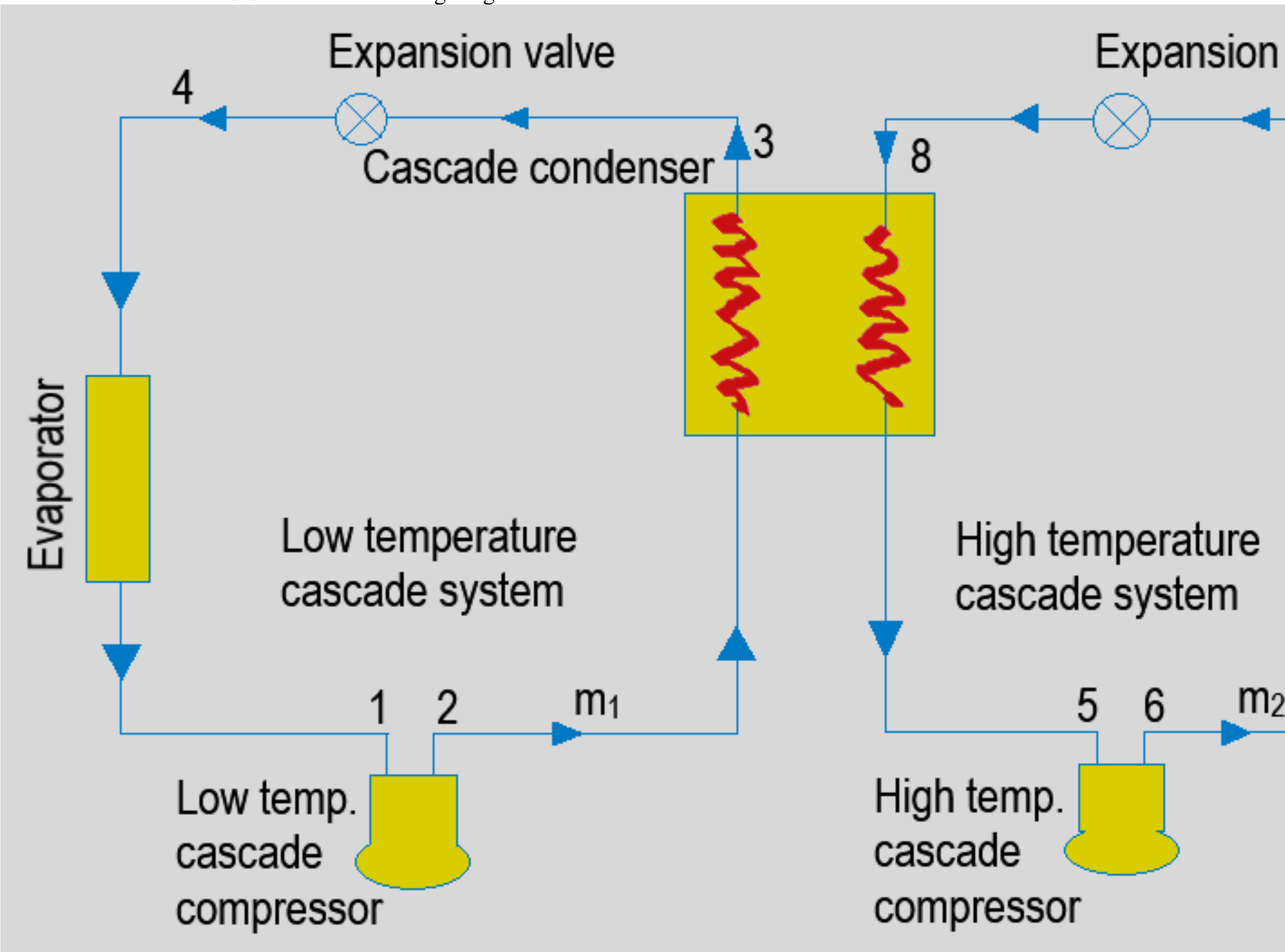
6. What is the value of work done in the following diagram?



a) $m_1 (h_2$ â€“ $h_4) + m_2 (h_5$ â€“ $h_6)$
b) $m_1 (h_2$ â€“ $h_1) + m_2 (h_6$ â€“ $h_5)$
c) $m_1 (h_2$ â€“ $h_8) + m_2 (h_5$ â€“ $h_8)$
d) $m_1 (h_2$ â€“ $h_5) + m_2 (h_4$ â€“ $h_8)$

Answer: b
Explanation: Work done is across the compressors.
Work = mass of refrigerant flowing through the compressor x change of enthalpy
Work done by low-temperature cascade system = $m_1 (h_2$ â€“ $h_1)$
Work done by high-temperature cascade system = $m_2 (h_6$ â€“ $h_5)$
Total work = Work done by low-temperature cascade system + Work done by high-temperature cascade system
Total work done = $m_1 (h_2$ â€“ $h_1) + m_2 (h_6$ â€“ $h_5)$.

7. What is the value of C.O.P. in the following diagram?

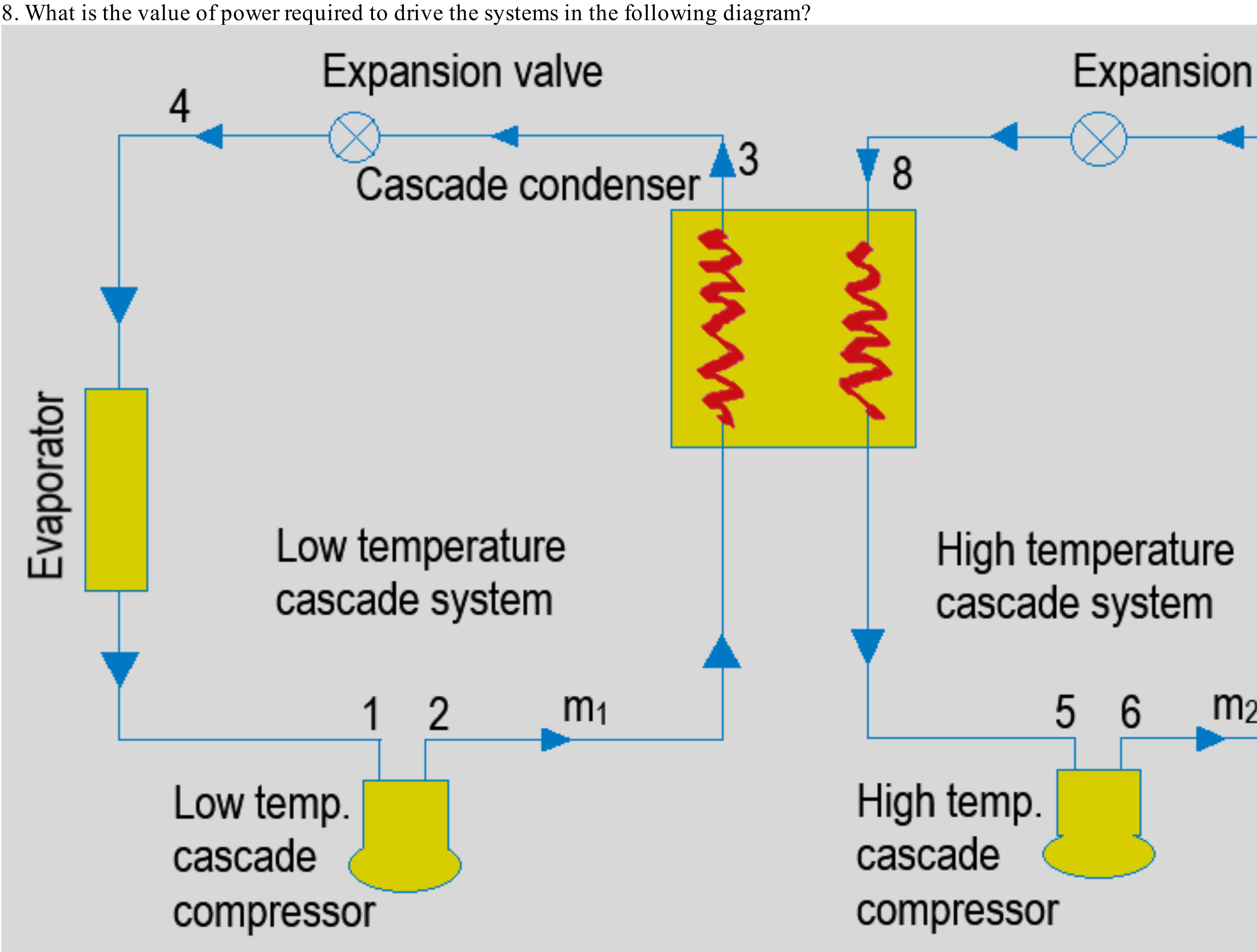


a) 210 Q / m_1 (h_2 â€“ h_4) + m_2 (h_5 â€“ h_6)

b) 210 Q / m_1 (h_2 â€“ h_7) + m_2 (h_6 â€“ h_8)
c) 210 Q / m_1 (h_2 â€“ h_8) + m_2 (h_5 â€“ h_8)
d) 210 Q / m_1 (h_2 â€“ h_1) + m_2 (h_6 â€“ h_5)

Answer: d
Explanation: As m_1 flows through the low-temperature cascade system. So, when it passes through the evaporator i.e. between point 1 and point 4, there is change in enthalpy which produces the refrigeration effect.
Hence, R.E. = m x delta h
= 210 Q where, Q is the load on the low-temperature cascade system in tones of refrigeration
Work = mass of refrigerant flowing through the compressor x change of enthalpy
Work done by low-temperature cascade system = m_1 (h_2 â€“ h_1)
Work done by high-temperature cascade system = m_2 (h_6 â€“ h_5)
Total work = Work done by low-temperature cascade system + Work done by high-temperature cascade system
Total work done = m_1 (h_2 â€“ h_1) + m_2 (h_6 â€“ h_5)
As, C.O.P. = Refrigeration effect / Total work done
= 210 Q / m_1 (h_2 â€“ h_1) + m_2 (h_6 â€“ h_5).

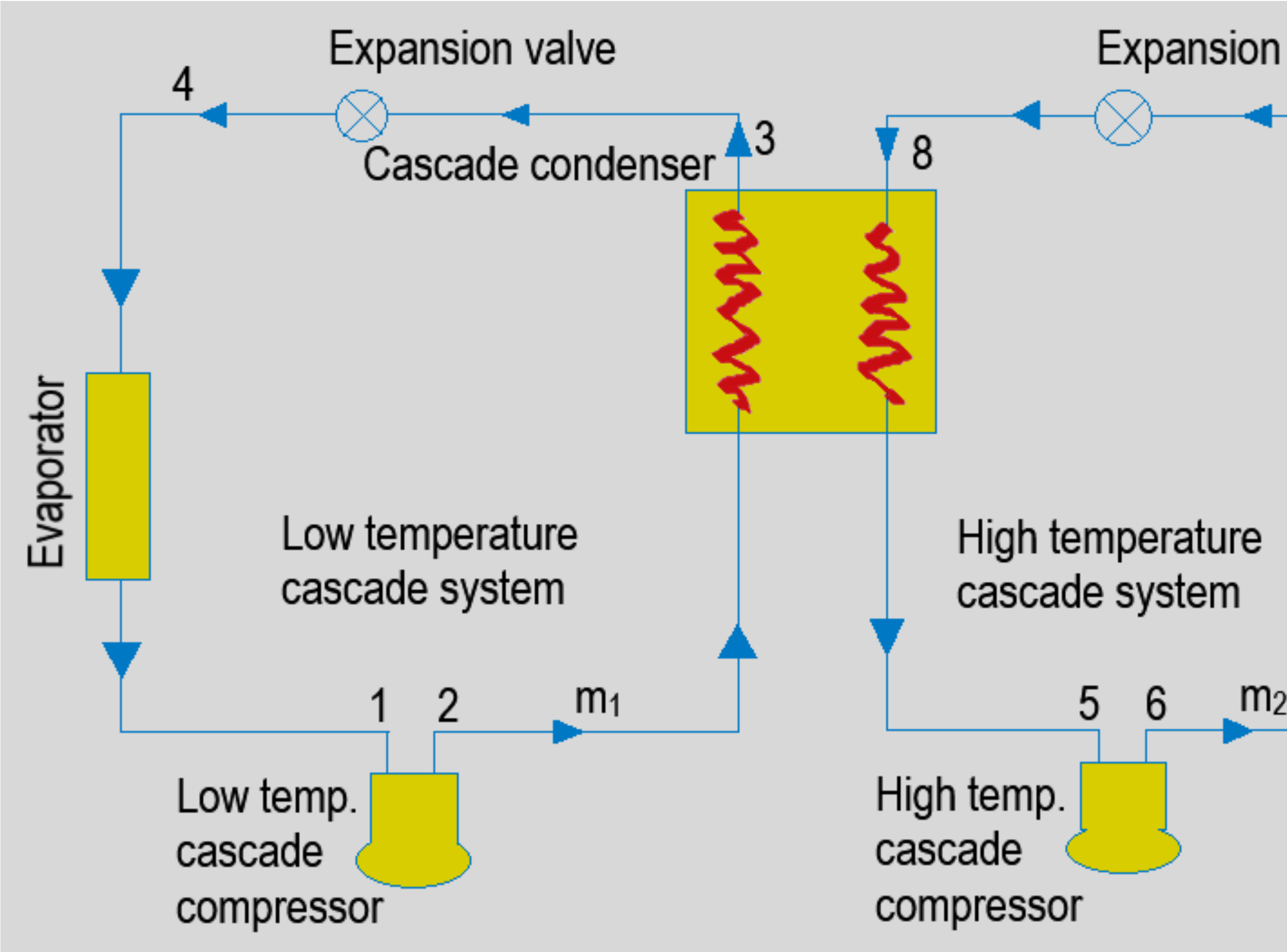
8. What is the value of power required to drive the systems in the following diagram?



a) m_1 (h_2 â€“ h_4) + m_2 (h_5 â€“ h_6) kW
b) m_1 (h_2 â€“ h_1) + m_2 (h_8 â€“ h_1) kJ/s
c) m_1 (h_2 â€“ h_1) + m_2 (h_6 â€“ h_5) kW
d) m_1 (h_2 â€“ h_1) + m_2 (h_6 â€“ h_5) kJ/min

Answer: c
Explanation: Power required to drive the system is the power required to do the work using compressors.
Work = mass of refrigerant flowing through the compressor x change of enthalpy
Work done by low-temperature cascade system = m_1 (h_2 â€“ h_1)
Work done by high-temperature cascade system = m_2 (h_6 â€“ h_5)
Total work = Work done by low-temperature cascade system + Work done by high-temperature cascade system
Total work done = m_1 (h_2 â€“ h_1) + m_2 (h_6 â€“ h_5) kJ/min
Power required = Work done / 60
= m_1 (h_2 â€“ h_1) + m_2 (h_6 â€“ h_5) kW.

9. What is the value of C.O.P. of low-temperature cascade system in terms of intermediate temperature in the following diagram?



If T_{EL} and T_{CL} = Evaporator and condenser temperatures for low-temperature cascade system

T_{EH} and T_{CH} = Evaporator and condenser temperatures for high-temperature cascade system

a) T_{EL} / T_{CL} â€“ T_{CL}

b) T_{CL} / T_{CL} â€“ T_{EL}

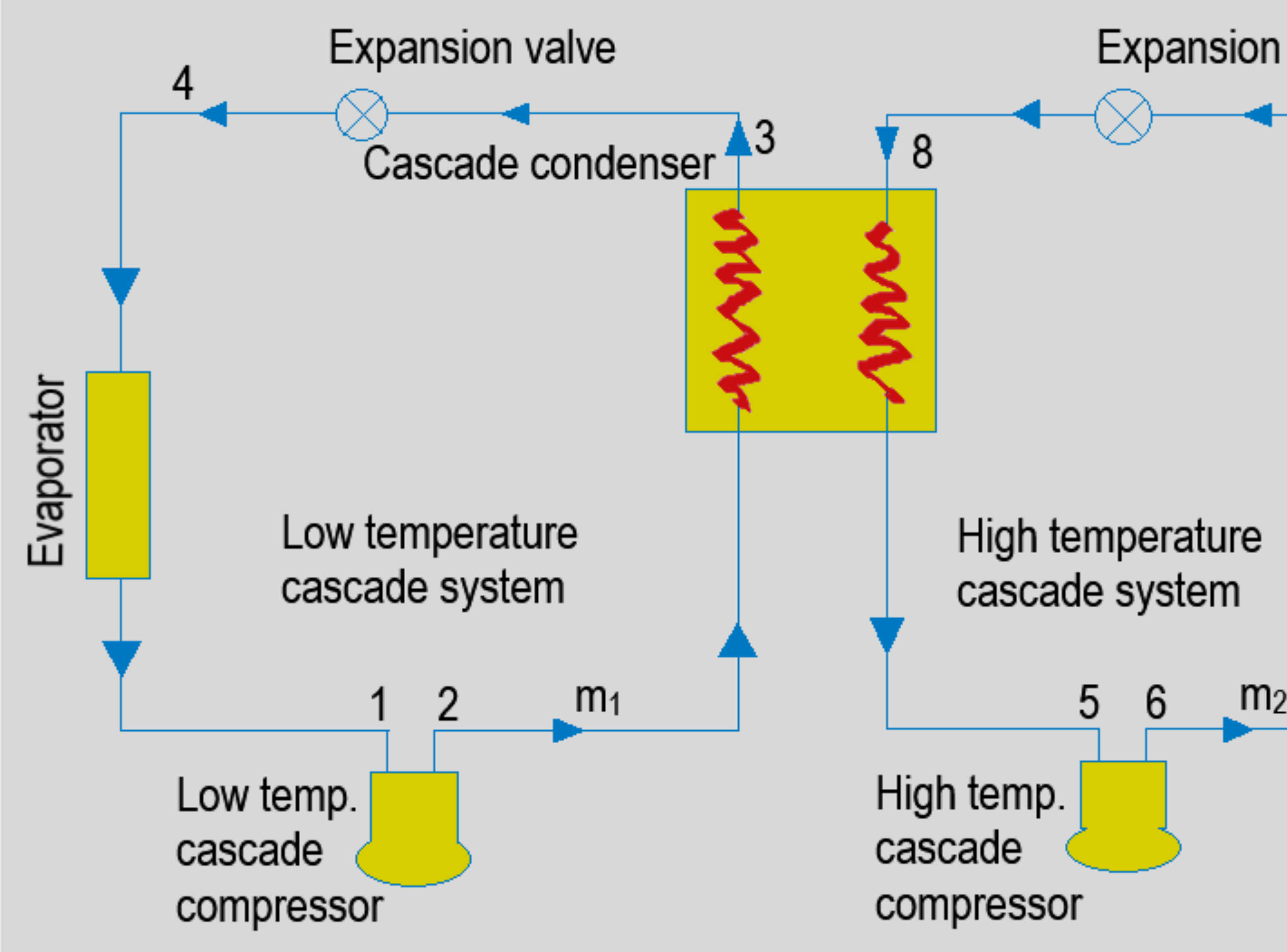
c) T_{CL} / T_I â€“ T_{CL}

d) T_{EL} / T_I â€“ T_{CL}

Answer: d

Explanation: Temperature of the condenser is higher than the temperature of the evaporator. The desired effect is obtained in the evaporator. So, by using the Carnotâ€™s theorem to low-temperature cascade system,
C.O.P. = Temperature of the evaporator / Temperature of the condenser â€“ Temperature of the evaporator
= T_{EL} / T_{CL} â€“ T_{EL}
As, when low-temperature cascade condenser temperature is equal to high-temperature cascade evaporator temperature.
$T_{CL} = T_{EH} = T_I$
Hence, C.O.P. = T_{EL} / T_I â€“ T_{CL} .

10. What is the value of C.O.P. of high-temperature cascade system in terms of intermediate temperature in the following diagram?

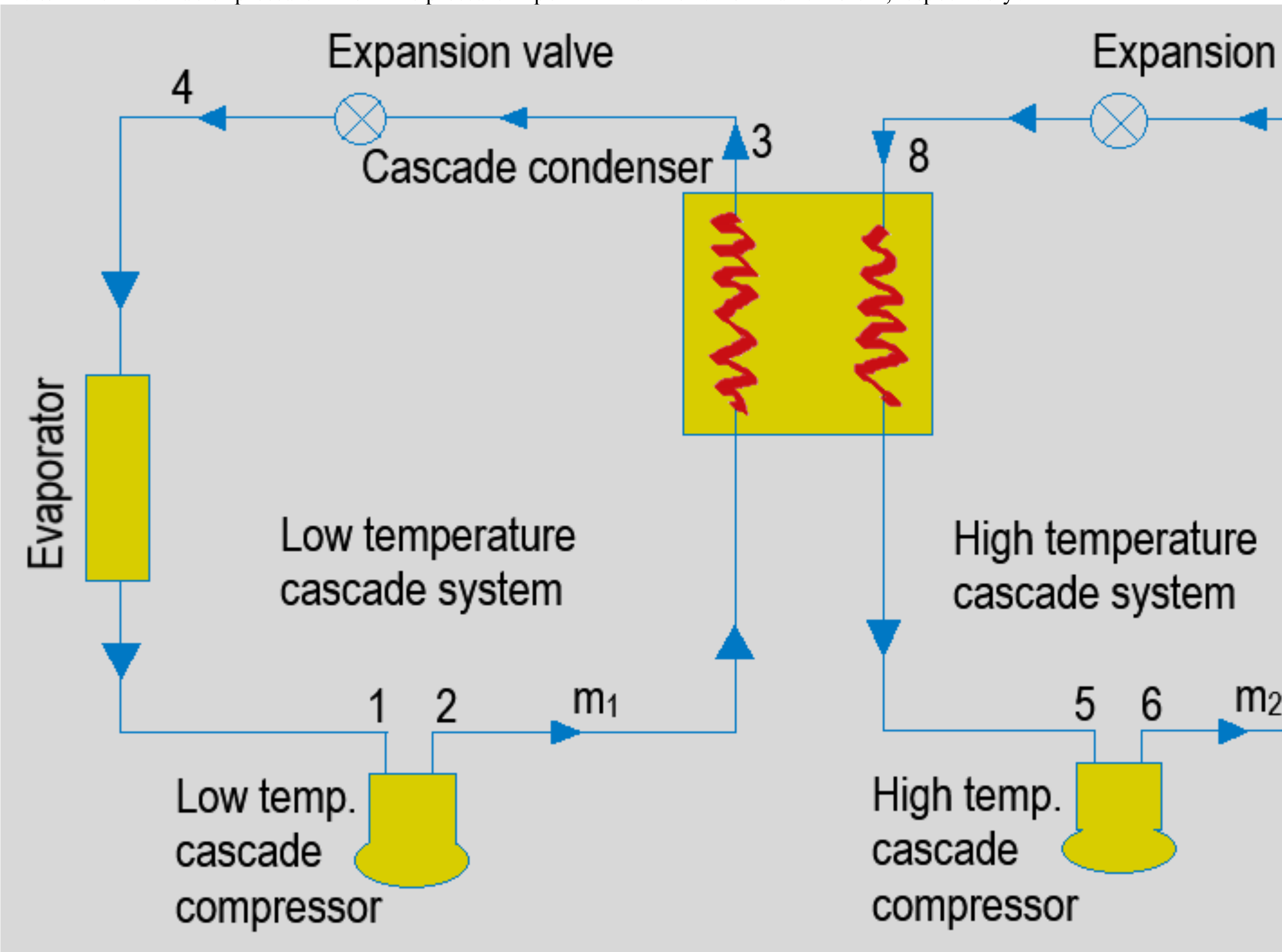


If T_{EL} and T_{CL} = Evaporator and condenser temperatures for low-temperature cascade system
T_{EH} and T_{CH} = Evaporator and condenser temperatures for high-temperature cascade system

a) T_{EH} / T_{CH} â€“ T_{CH}
b) T_I / T_{CH} â€“ T_I
c) T_{CH} / T_I â€“ T_{CH}
d) T_{EH} / T_I â€“ T_{CH}

Answer: b
Explanation: Temperature of the condenser is higher than the temperature of the evaporator. The desired effect is obtained in the evaporator. So, by using the Carnotâ€™s theorem to high-temperature cascade system,
C.O.P. = Temperature of the evaporator / Temperature of the condenser â€“ Temperature of the evaporator
= T_{EH} / T_{CH} â€“ T_{EH}
As, when low-temperature cascade condenser temperature is equal to high-temperature cascade evaporator temperature.
$T_{CL} = T_{EH} = T_I$
Hence, C.O.P. = T_I / T_{CH} â€“ T_I .

11. What is the value of pressure ratio if the pressure at point 1 and 2 is 1.809 and 3.467 bar, respectively?



a) 1.916

b) 1.916 bar
c) 0.521
d) 0.521 bar

Answer: a
Explanation: Pressure ratio is the ratio of pressure after the compression and pressure before the compression. As compression is completed at point 2 from the diagram.
So, pressure ratio = P_2 / P_1
= 3.467 / 1.809
= 1.916.
Pressure ratio is the ratio of two same quantities, so this value does not have any unit.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œExpansion Devicesâ€�.

1. The device which divides the high pressure side and the low pressure side of a refrigerating system is known as ______________
a) condenser device
b) evaporator device
c) receiver device
d) expansion device

Answer: d
Explanation: The expansion device is an important device that divides the high pressure side and the low pressure side of a refrigerating system. It is also known as metering device or throttling device.

2. Which of the following function is not performed by the expansion device?
a) It reduces the high pressure liquid refrigerant to low pressure liquid refrigerant
b) It maintains the desired pressure difference between the high and low pressure sides of the system
c) It controls the flow of refrigerant according to the load on the evaporator
d) It compresses the vapor

Answer: d
Explanation: The expansion device performs the following functions, it reduces the high pressure liquid refrigerant to low pressure liquid refrigerant, it maintains the desired pressure difference between the high and low pressure sides of the system and It controls the flow of refrigerant according to the load on the evaporator.

3. The expansion device used with flooded evaporators is known as expansion valves.
a) True
b) False

Answer: b
Explanation: The expansion device used with flooded evaporators is known as float valves and the expansion device used with dry expansion evaporators are called expansion valves.

4. The expansion device is placed between which two components?
a) Condenser and evaporator
b) Compressor and condenser
c) Evaporator and compressor
d) Receiver and evaporator

Answer: d
Explanation: The expansion device is placed between receiver (containing liquid refrigerant at high pressure) and evaporator (containing liquid refrigerant at low pressure).

5. Which of the following is not an advantage of capillary tube?
a) The cost of capillary tube is less
b) A high starting motor is not required
c) No receiver is needed
d) A capillary tube designed for a specific condition will also work efficiently for other conditions

Answer: d
Explanation: A capillary tube designed for a specific condition will not work efficiently for other conditions as the length is directly and inner diameter is indirectly proportional to the frictional resistance. The longer the tube and smaller the diameter, greater is the pressure drop created in the refrigerant flow.

6. Capillary tube, as an expansion device is used in?
a) Water coolers
b) Domestic refrigerators

c) Room air conditioners
d) All of the mentioned

Answer: d
Explanation: The capillary tube as an expansion device is used in small capacity hermetic sealed refrigeration units such as in water coolers, domestic refrigerators and room air conditioners, etc.

7. Which one of the following is also known as a constant superheat valve?
a) Capillary tube
b) Hand-operated expansion valve
c) Thermostatic Expansion valve
d) Low side float valve

Answer: d
Explanation: Thermostatic expansion valve is also called a constant superheat valve because it maintains a constant superheat of the vapor refrigerant at the end of the evaporator coil, by controlling the flow of liquid refrigerant through the evaporator.

8. Thermostatic expansion valves are usually set for a superheat of?
a) 10Â°C
b) 5Â°C
c) 8Â°C
d) 15Â°C

Answer: b
Explanation: Thermostatic expansion valves are usually set for a superheat of 5Â°C for better efficiency of the refrigeration cycle.

9. The low-side float valve is located between the condenser and evaporator.
a) True
b) False

Answer: b
Explanation: The low-side float valve is located in the low pressure side i.e. between the evaporator and the compressor suction line. Whereas the high side float valve is located in the high pressure side i.e. between the condenser and evaporator.

10. The thermostatic expansion valve operates on the changes in the ____________
a) degree of superheat at exit from the evaporator
b) temperature of the evaporator
c) pressure in the condenser
d) pressure in the evaporator

Answer: a
Explanation: The thermostatic expansion valve operates on the changes in the degree of superheat at exit from the evaporator. Thermostatic expansion valves are usually set for a superheat of 5Â° C for better efficiency of the refrigeration cycle.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œIdeal VAR Systemâ€�.

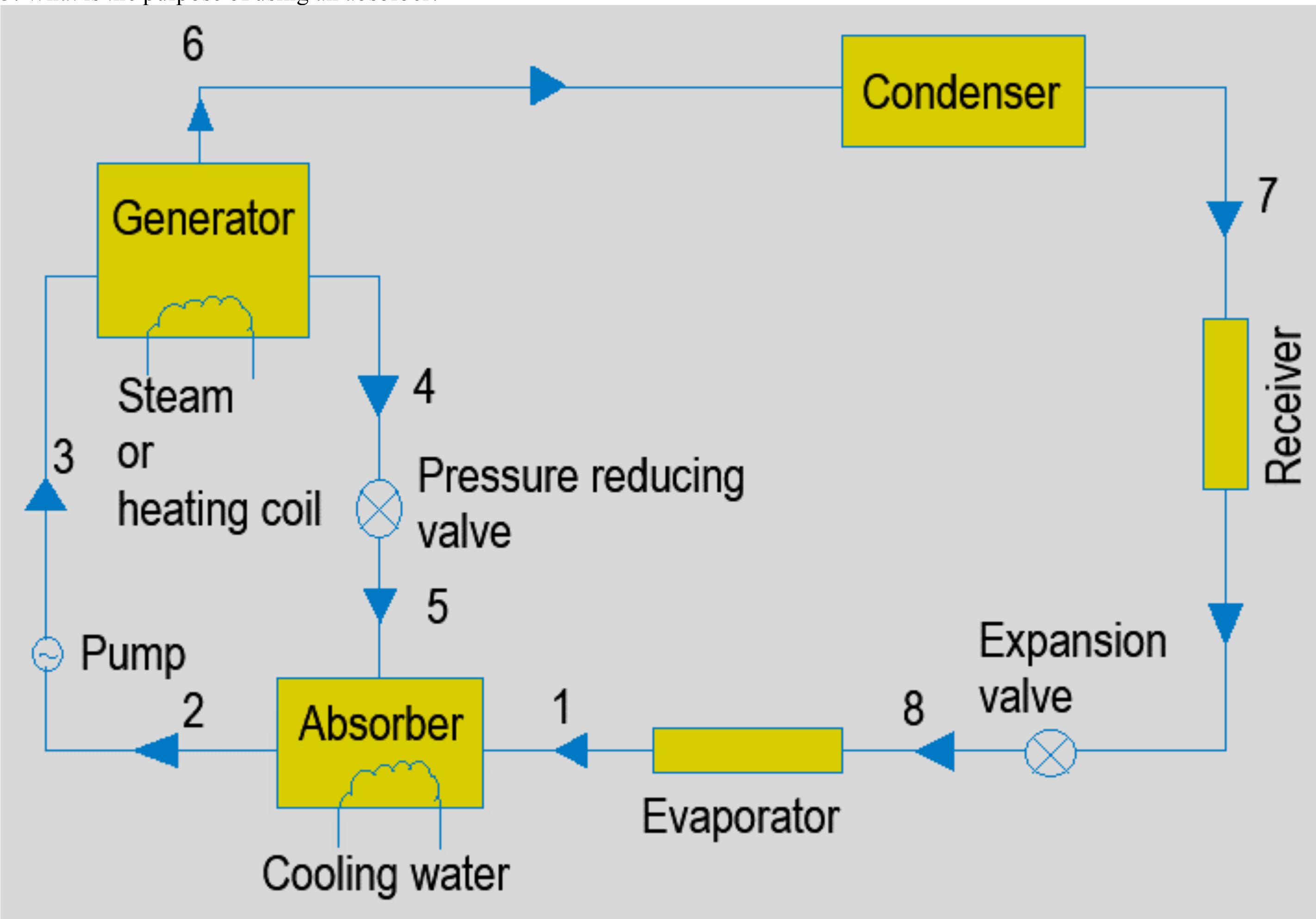
1. Which of the following is correct about VARS and VCRS?
a) VARS use mechanical energy, and VCRS use heat energy
b) VARS use heat energy, and VCRS use mechanical energy
c) Both use mechanical energy
d) Both use heat energy

Answer: b
Explanation: VCRS use mechanical energy i.e., VCRS uses compressor which withdraws energy from the evaporator and drawn into condenser after compression. VARS use heat energy i.e., heat exchanger or heat generators are used and by which desired effect is achieved.

2. The compressor from VCRS is replaced by which of the following in the VARS?
a) Absorber, Pump
b) Generator, Pressure reducing valve
c) Absorber, Pump, Generator, and Pressure reducing valve
d) Absorber, Rectifier, Generator, and Pressure reducing valve

Answer: c
Explanation: Compressor from the VCRS is replaced by an absorber, a pump, a generator, and a pressure reducing valve. These all components together do the same work as a compressor but by using the heat energy.

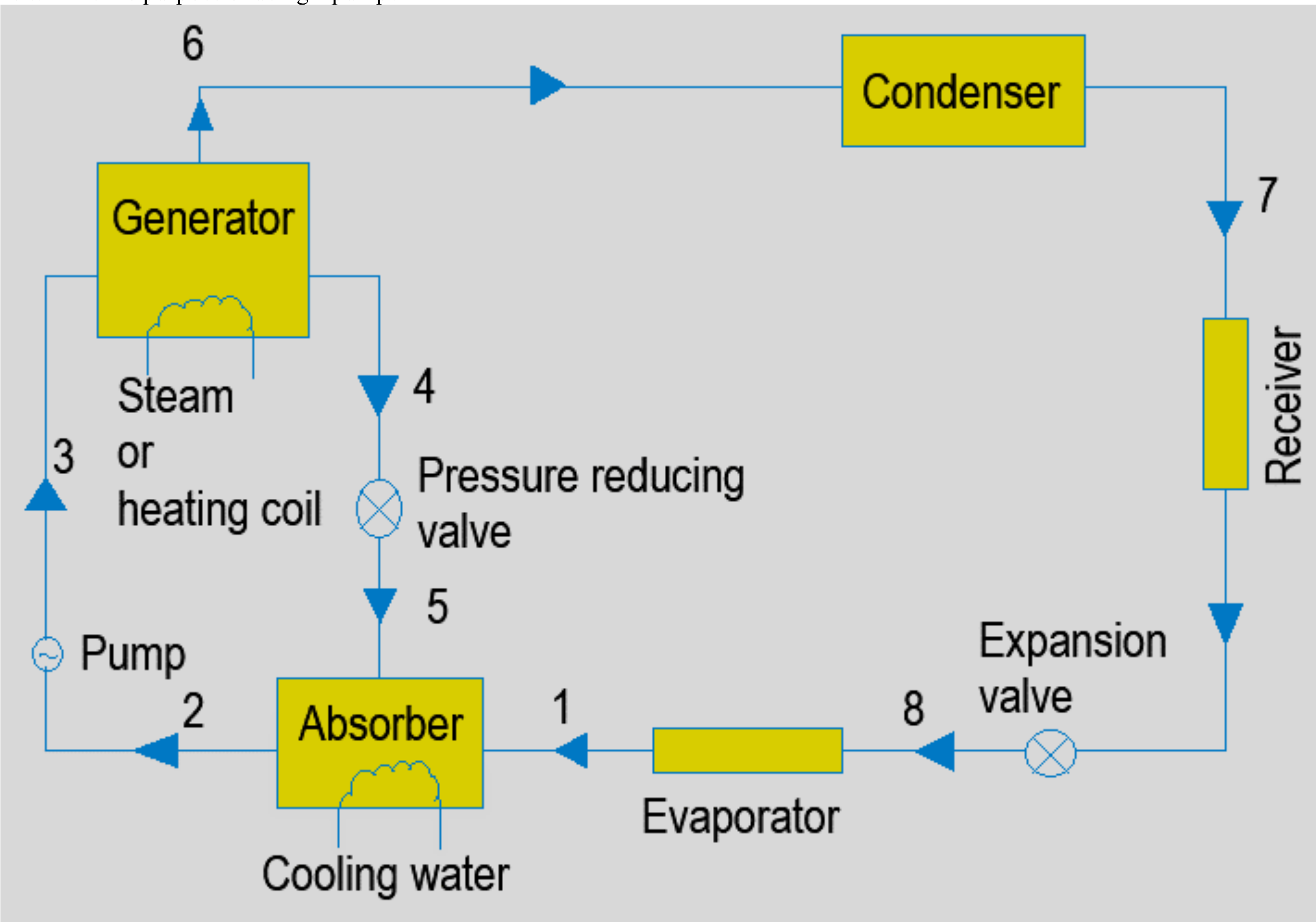
3. What is the purpose of using an absorber?



a) Heat absorption
b) Heat rejection
c) Pressure reduction
d) Work done

Answer: b
Explanation: Vapour refrigerant from the evaporator enters the absorber. Cooling water is circulated to transfer the heat, and refrigerantâ€™s strong solution is discharged to the generator.

4. What is the purpose of using a pump?

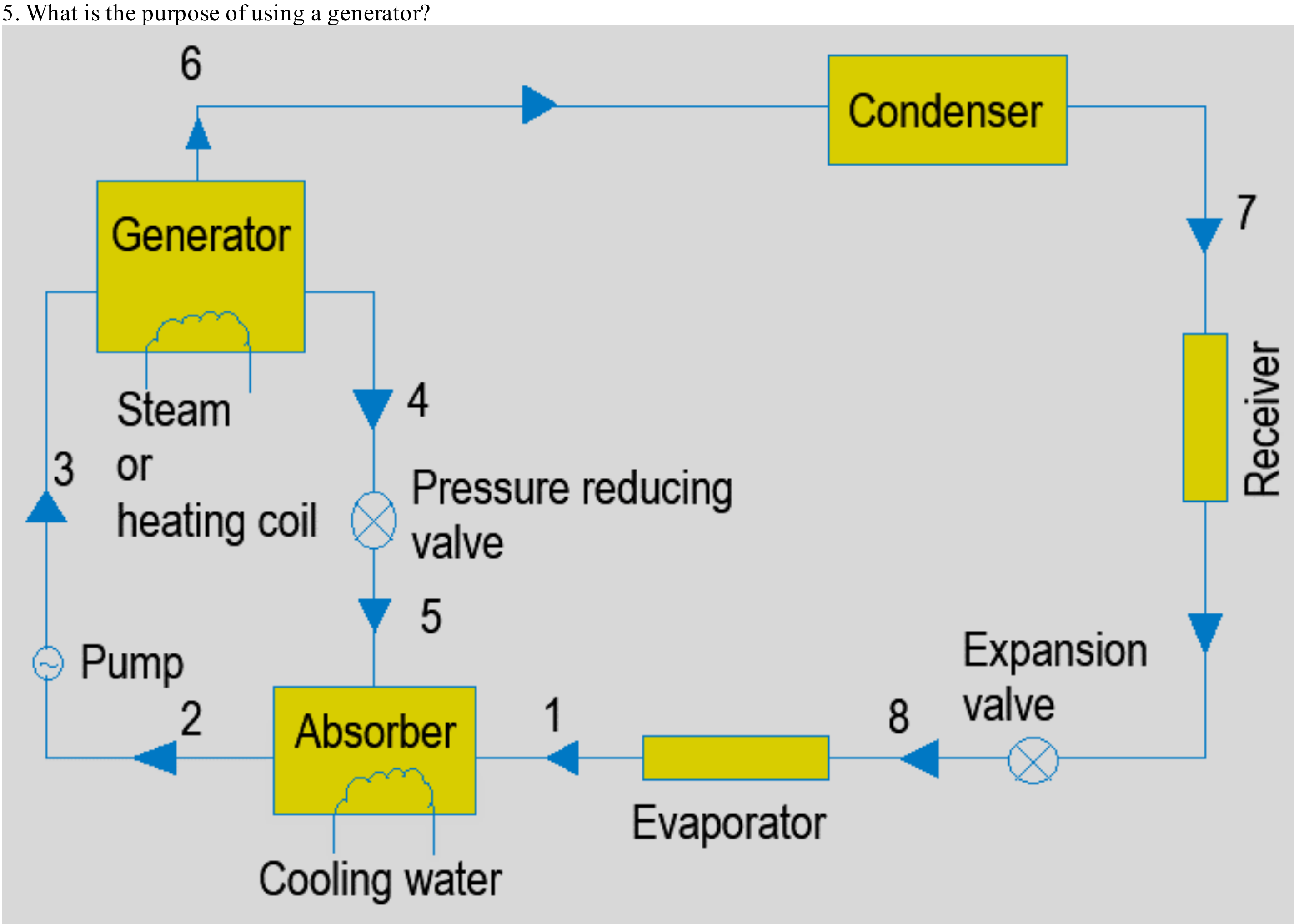


a) Heat absorption

b) Heat rejection
c) Pressure reduction
d) Pressure increment

Answer: d
Explanation: The strong solution discharging from the absorber is pumped to the generator using a liquid pump. The liquid pump increases the pressure up to 10 bar.

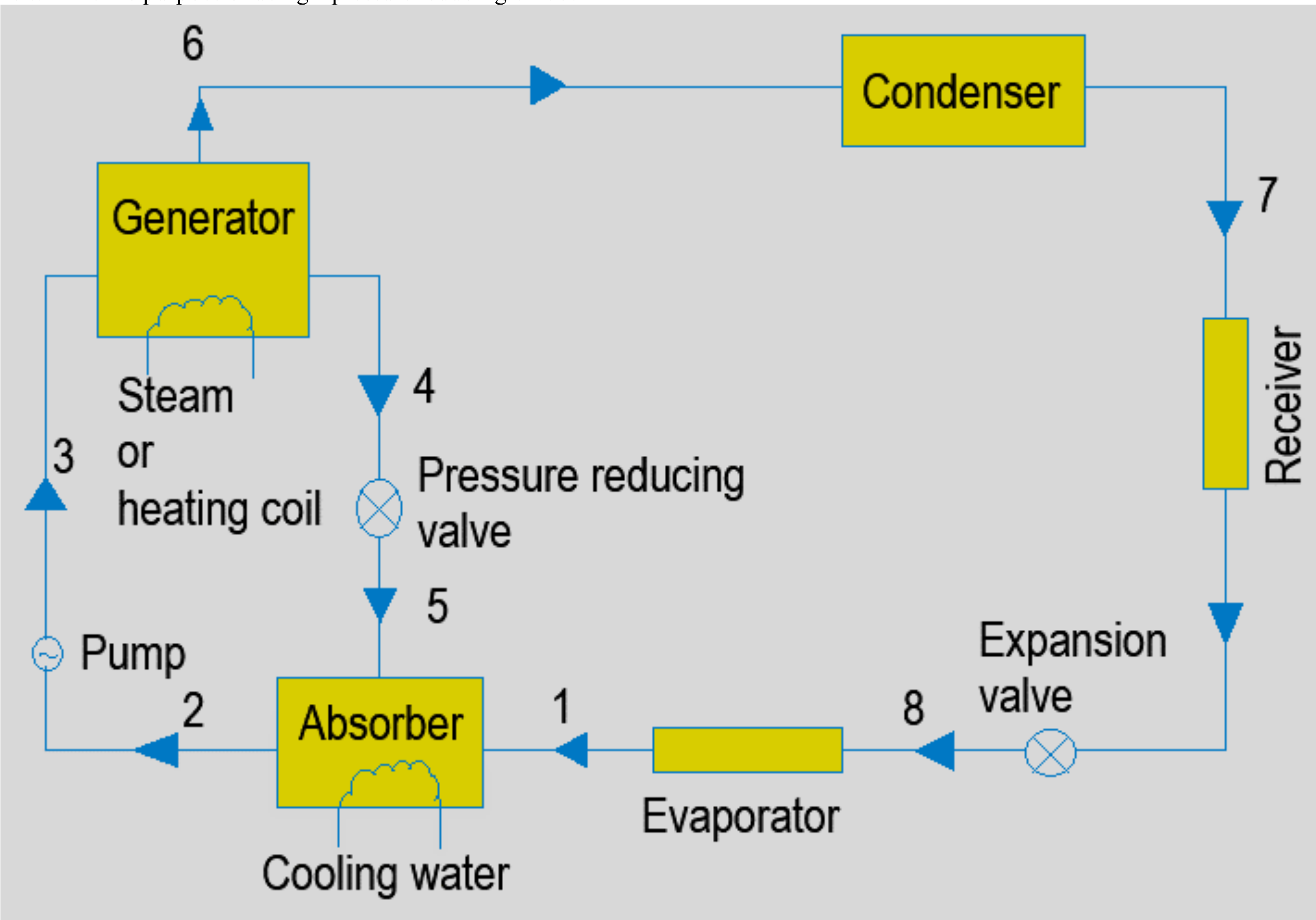
5. What is the purpose of using a generator?



a) Heat supplied
b) Heat rejection
c) Pressure reduction
d) Pressure increment

Answer: a
Explanation: Generator generates heat. From the generator, heat is supplied to the refrigerant, and the strong refrigerant is heated further by using some external source like gas or steam.

6. What is the purpose of using a pressure reducing valve?

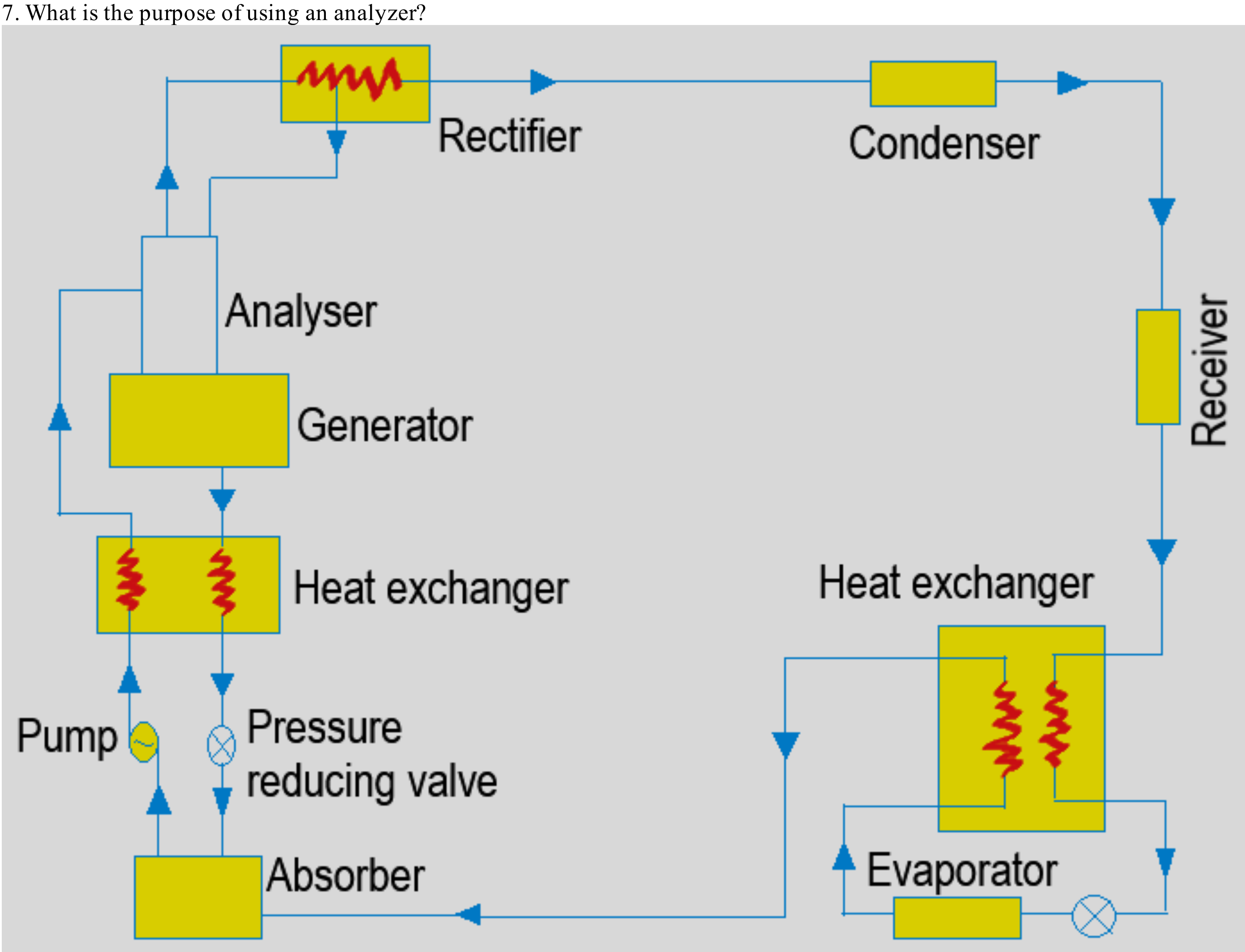


a) Heat supplied

b) Heat rejection
c) Pressure reduction
d) Pressure increment

Answer: c
Explanation: As the name suggests, pressure reducing valve reduces the pressure of a weak solution of refrigerant, and a weak solution is discharged into an absorber to make again it a strong solution.

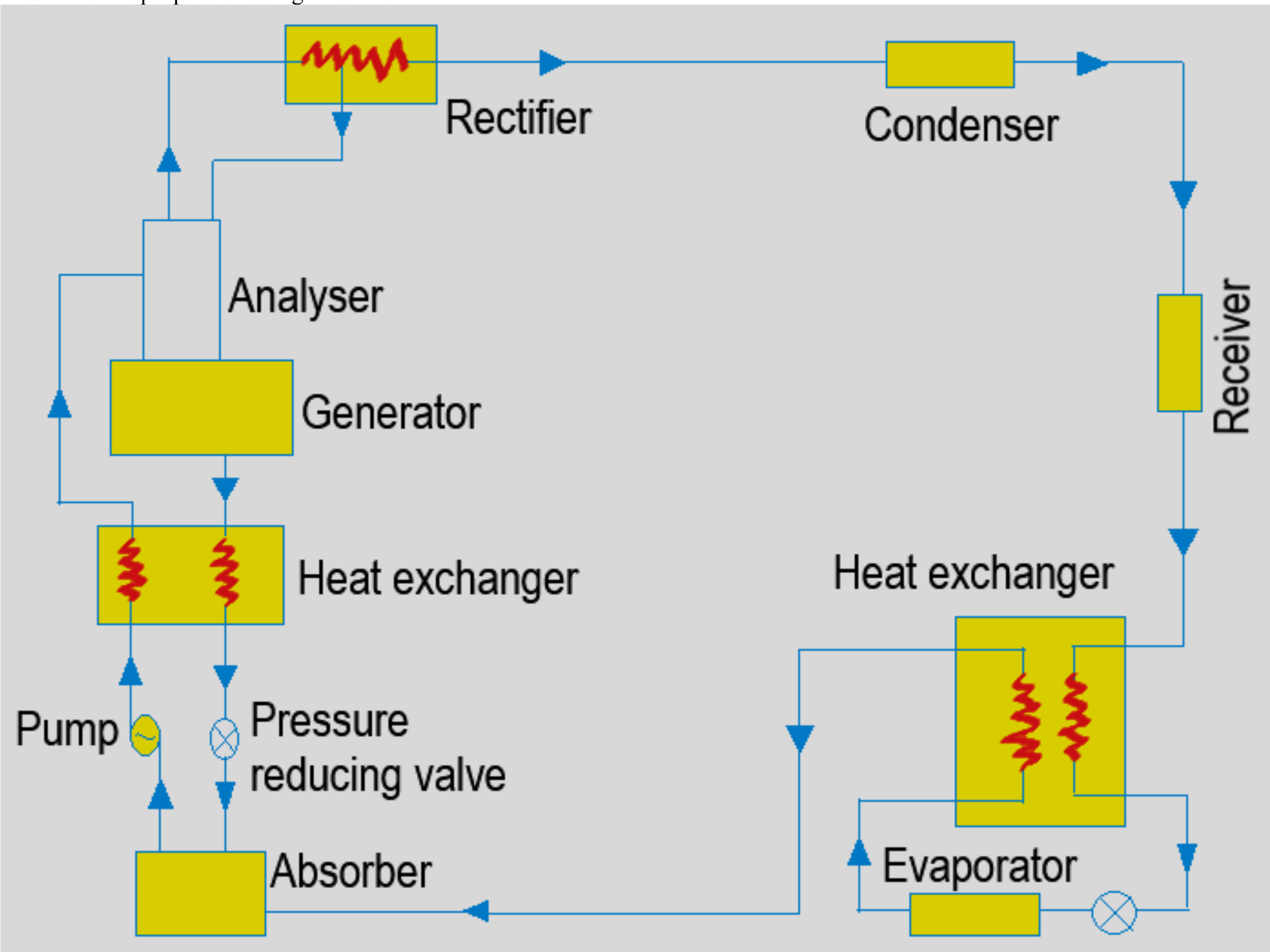
7. What is the purpose of using an analyzer?



a) Heat supplied
b) Removal of unwanted water particles
c) Pressure reduction
d) Removal of unwanted ammonia particles

Answer: b
Explanation: Analyzer is used to remove unwanted particles from entering the condenser. If the unwanted water particles enter the condenser, then these particles will enter the expansion valve too. These particles will freeze if passed through an expansion valve and will choke the pipeline.

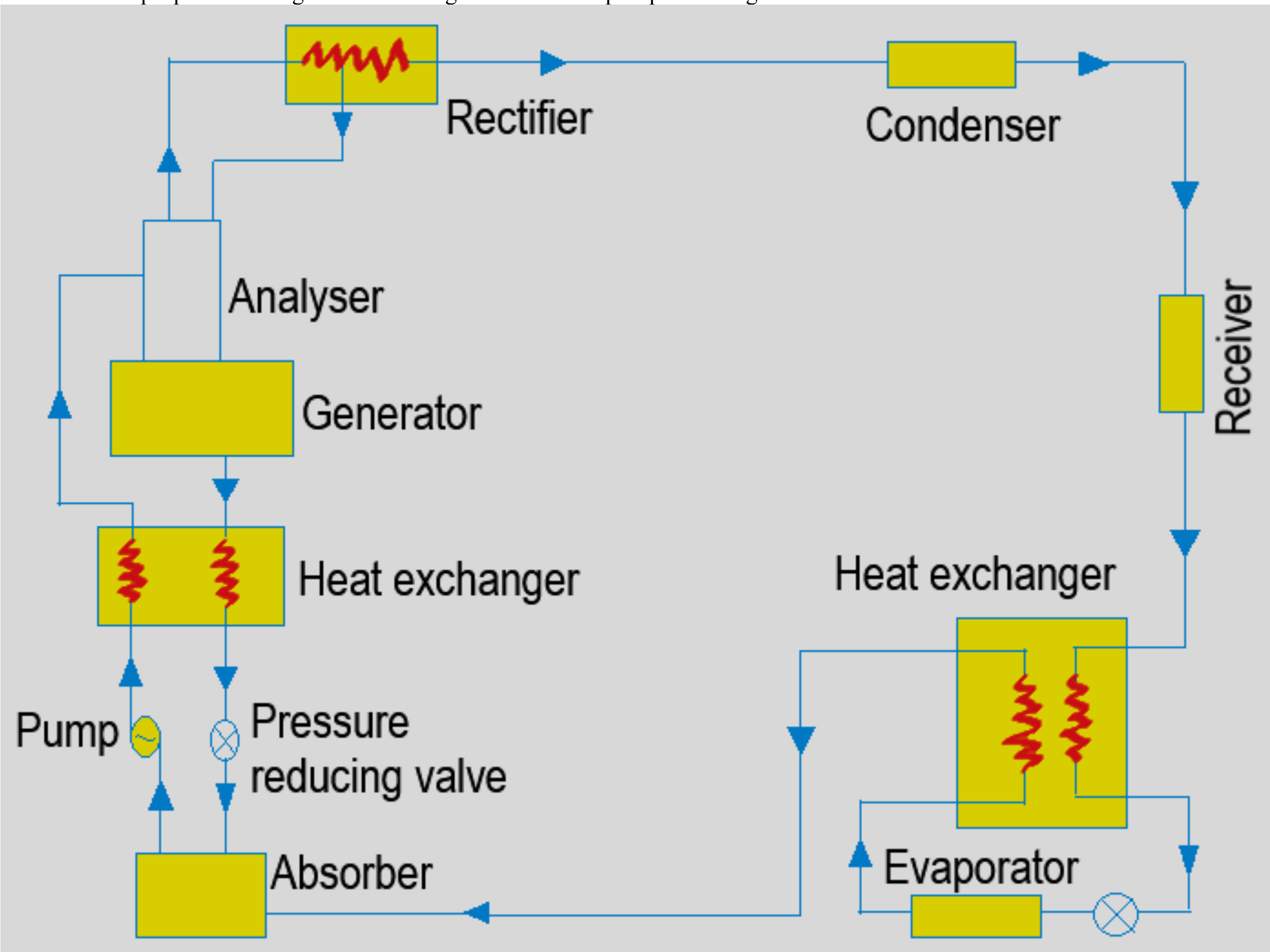
8. What is the purpose of using a rectifier?



a) Removal of all water particles by cooling
b) Heat supplied
c) Pressure reduction
d) Removal of unwanted ammonia particles

Answer: a
Explanation: Water vapors are not entirely removed in an analyzer, to condensate pure ammonia refrigerant, rectifier or dehydrator is used. Its function is to cool refrigerant coming out of an analyzer and condensate from rectifier returns to the analyzer by using the drip pipe.

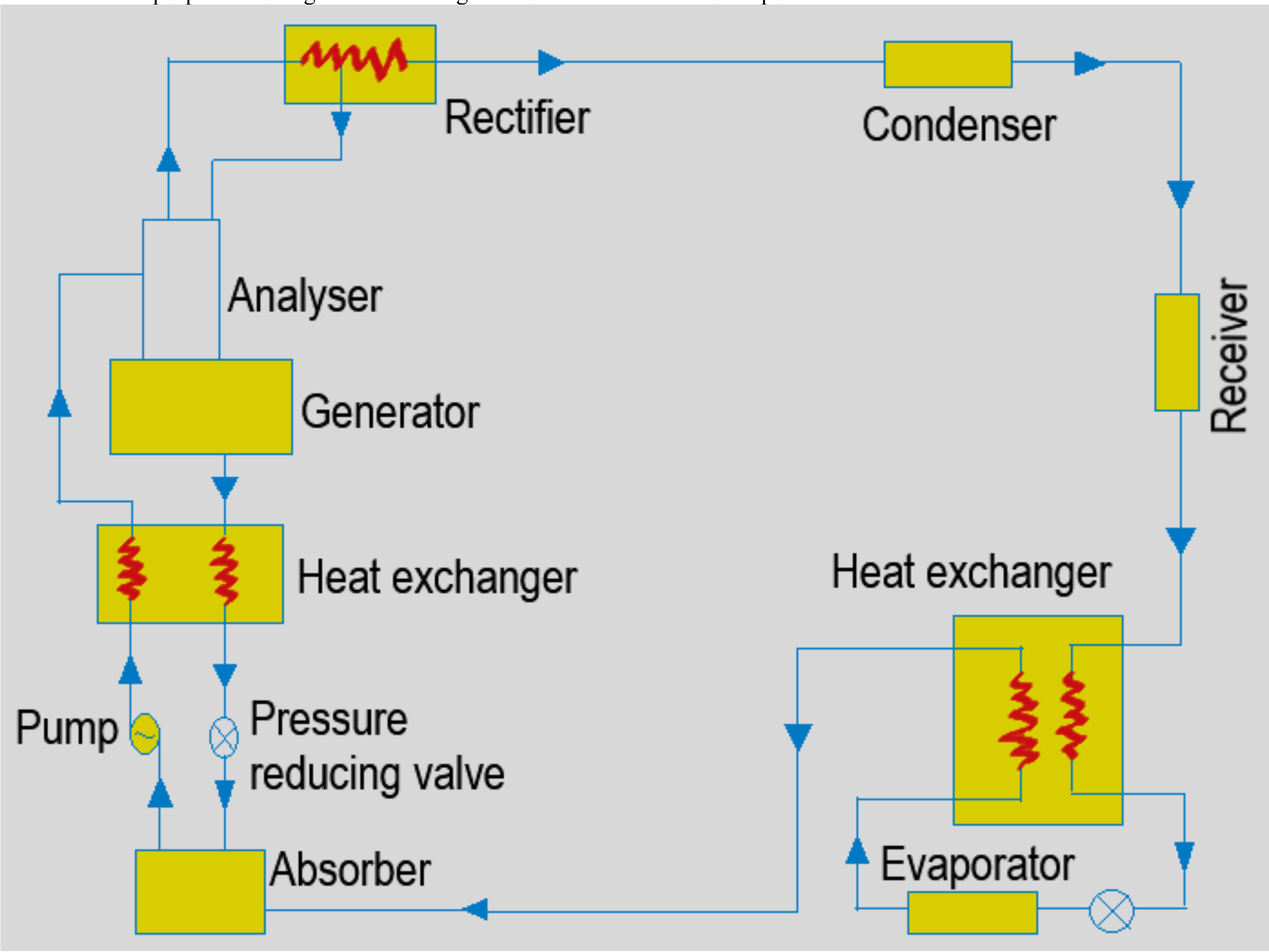
9. What is the purpose of using a heat exchanger between the pump and the generator?



a) Cool the strong hot solution
b) Heat the strong hot solution
c) Heat the weak hot solution
d) Cool the weak hot solution

Answer: d
Explanation: Heat exchanger between the pump and the generator is used to cool the weak hot solution of ammonia and water. The heat removed from the weak solution increases the temperature of the strong solution discharging the pump and entering the generator. Use of heat exchanger increases the economy of the plant.

10. What is the purpose of using a heat exchanger between condenser and evaporator?



a) Heat the water particles
b) Heat the strong hot solution
c) Heat the weak hot solution
d) Sub-cooling of the refrigerant

Answer: d
Explanation: Heat exchanger between the condenser and the evaporator is used to sub-cool the refrigerant. Heat exchanger acts as a liquid sub-cooler. Refrigerant discharging from the condenser is sub-cooled by the low-temperature ammonia vapour in the evaporator.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œCoefficient of Performance of Ideal VAR System â€“ 1â€�.

1. What is the formula for COP of an ideal vapour absorption refrigeration system?
Q_g = the heat given to the refrigerant in the generator
Q_e = the heat absorbed by the refrigerant in the evaporator
a) $\frac{Q_e}{Q_g}$
b) $\frac{Q_g}{Q_e}$
c) Q_g Ã— Q_e
d) Q_g â€“ Q_e

Answer: a
Explanation: The COP of an ideal vapour absorption refrigeration system is the ratio of the heat given to the refrigerant in the generator and the heat absorbed by the refrigerant in the evaporator.
COP = $\frac{Q_e}{Q_g}$.

2. An ideal vapour absorption refrigeration system may be regarded as a combination of __________
a) Carnot engine and Carnot pump
b) Carnot refrigerant and Carnot pump
c) Carnot engine and Carnot refrigerant
d) Carnot engine alone

Answer: c
Explanation: An ideal vapour absorption refrigeration system may be regarded as a combination of Carnot engine and Carnot refrigerant.
COP = \(\frac{Q_e}{Q_g}\).

3. Find the COP of a vapour absorption refrigeration system using the following data.
$Q_g = 6600$
$Q_e = 2100$
a) 0.45
b) 0.65
c) 0.31
d) 0.35

Answer: c
Explanation: The COP of an ideal vapour absorption refrigeration system is
COP = \(\frac{Q_e}{Q_g}\)
COP = \(\frac{2100}{6600}\) = 0.31.

4. Find the COP of a vapour absorption refrigeration system using the following data.
$T_e = 268$
$T_g = 393.2$
$T_c = 303$
a) 1.53
b) 1.76
c) 1.66
d) 1.98

Answer: b
Explanation: The COP of an ideal vapour absorption refrigeration system is
COP = \(\frac{Q_e}{Q_g}\)
= \(\frac{T_e}{T_c â€“ T_e} Ã— \frac{T_g-T_c}{T_g}\)
= \((\frac{268}{303-268})*(\frac{393.2-303}{393.2})\)
= 1.76.

5. The expression \(\frac{T_e}{T_c â€“ T_e}\) in the formula for COP i.e. \(\frac{T_e}{T_c â€“ T_e} Ã— \frac{T_g-T_c}{T_g}\) refers to ___________
T_e and T_c are the temperature limits for Carnot refrigerator
T_g and T_c are the temperature limits for Carnot engine
a) COP of Carnot engine
b) COP of Carnot refrigerator
c) COP of Carnot pump
d) COP of Bell-Coleman cycle

Answer: b
Explanation: An ideal vapour absorption refrigeration system may be regarded as a combination of Carnot engine and Carnot refrigerant. Hence the expression \(\frac{T_e}{T_c â€“ T_e}\) refers to the COP of Carnot refrigerator and the second expression \(\frac{T_g}{T_c â€“ T_g}\) refers to Carnot engine.

6. In case the heat is discharged at different temperatures in condenser and absorber then the formula for COP would be?
T_a = Temperature at which heat is discharged in the absorber
T_e and T_c are the temperature limits for Carnot refrigerator
T_g and T_c are the temperature limits for Carnot engine
a) COP = \(\frac{T_e}{T_c â€“ T_e} Ã— \frac{T_g-T_c}{T_g}\)
b) COP = \(\frac{T_e}{T_c â€“ T_e} Ã— \frac{T_g-T_c}{T_g} Ã— T_a\)
c) COP = \(\frac{T_e}{T_c â€“ T_e} Ã— \frac{T_g-T_c}{T_g} Â± T_a\)
d) COP = \(\frac{T_e}{T_c â€“ T_e} Ã— \frac{T_g-T_c}{T_g}\)

Answer: d
Explanation: In case the heat is discharged at different temperatures in condenser and absorber then the formula for COP would be
COP = \(\frac{T_e}{T_c â€“ T_e} Ã— \frac{T_g-T_a}{T_g}\).

7. Find the COP of an ideal vapour absorption refrigeration system using the following data.
$Q_g = 1880$
$Q_e = 1045$
a) 0.47
b) 0.65
c) 0.69
d) 0.55

Answer: d
Explanation: The COP of an ideal vapour absorption refrigeration system is
COP = $\frac{Q_e}{Q_g}$
COP = $\frac{1045}{1880}$ = 0.555.

This set of Refrigeration Assessment Questions and Answers focuses on â€œCoefficient of Performance of Ideal VAR System â€“ 2â€�.

1. What is the fundamental equation of the C.O.P. of Ideal VAR system?
a) Heat absorbed in the evaporator / Work done by a pump
b) Heat absorbed in the evaporator / Heat supplied in the generator
c) Heat absorbed in the evaporator / Work done by compressor + Heat supplied in the generator
d) Heat absorbed in the evaporator / Work done by pump + Heat supplied in the generator

Answer: d
Explanation: VAR uses the generator to do work as well as pump to pressurize the liquid to the generator. So, total work done is the summation of work done by a pump and generator. Refrigeration effect is the heat absorbed in the evaporator.
So, C.O.P. = Refrigeration effect / Total work done
= Heat absorbed in the evaporator / Work done by pump + Heat supplied in the generator.

2. What is the relation between Q_C, Q_G, and Q_E if they represent heat given to the refrigerant in the generator, heat discharging to atmosphere from condenser to absorber and heat absorbed by the refrigerant in the evaporator?
a) $Q_C + Q_G = Q_E$
b) $Q_C = Q_G + Q_E$
c) $Q_C + Q_E = Q_G$
d) $Q_C = Q_G$ â€“ Q_E

Answer: b
Explanation: According to the first law of thermodynamics, heat discharged to the atmosphere or cooling water from the condenser to absorber is equal to the heat given to the refrigerant in a generator, heat absorbed by the refrigerant in the evaporator and heat added to the refrigerant due to pump work. Heat added due to pump work is neglected due to minimal effect.
So, $Q_C = Q_G + Q_E$

3. What is the equation of VAR system in terms of entropy?
a) $Q_C + Q_E / T_C = Q_G / T_G + Q_E / T_E$
b) $Q_G + Q_C / T_C = Q_G / T_G + Q_E / T_E$
c) $Q_G + Q_E / T_C = Q_G / T_G + Q_E / T_E$
d) $Q_G + Q_E / T_C = Q_C / T_C + Q_E / T_E$

Answer: c
Explanation: As vapour absorption system is considered as a perfectly reversible system,
Hence the initial entropy of the system should be equal to the entropy of the system after some change in its conditions.
As entropy is heat absorbed divided by the temperature.
From the first law of thermodynamics, $Q_C = Q_G + Q_E$
So, the equation in terms of entropy $Q_C / T_C = Q_G / T_G + Q_E / T_E$
Modified as, $Q_G + Q_E / T_C = Q_G / T_G + Q_E / T_E$

4. What is the ratio of Q_G / Q_E in terms of temperature?
If T_C, T_G and T_E if they represent temperature at which heat is given to the refrigerant in the generator, temperature at which heat is discharging to atmosphere from condenser to absorber and temperature at which heat is

absorbed by refrigerant in the evaporator
a) $[T_C$ â€“ $T_E / T_E] [T_G / T_G$ â€“ $T_C]$
b) $[T_C$ â€“ $T_E / T_E] [T_G / T_G$ â€“ $T_E]$
c) $[T_C$ â€“ $T_E / T_E] [T_C / T_G$ â€“ $T_C]$
d) $[T_C$ â€“ $T_E / T_C] [T_G / T_G$ â€“ $T_C]$

Answer: a
Explanation: By using the phenomenon of perfectly reversible system,
$Q_G + Q_E / T_C = Q_G / T_G + Q_E / T_E$
Q_G / T_G â€“ $Q_G / T_C = Q_E / T_C$ â€“ Q_E / T_E
$Q_G [T_C$ â€“ $T_G / T_C \text{ x } T_G] = Q_E [T_E$ â€“ $T_C / T_C \text{ x } T_E]$
By rearranging, $Q_G / Q_E = [T_C$ â€“ $T_E / T_E] [T_G / T_G$ â€“ $T_C]$

5. What is the value of maximum C.O.P. in terms of heat?
a) Q_G / Q_E
b) Q_E / Q_G
c) Q_G / Q_C
d) Q_C / Q_E

Answer: b
Explanation: As VAR uses the generator to do work as well as pump to pressurize the liquid to the generator. So, total work done is the summation of work done by a pump and generator. Refrigeration effect is the heat absorbed in the evaporator.
So, C.O.P. = Refrigeration effect / Total work done
= Heat absorbed in the evaporator / Work done by pump + Heat supplied in the generator
For maximum C.O.P., due to the minimal effect of work done by a pump, Q_P is neglected.
Q_E = Heat absorbed in the evaporator and Q_G = Heat supplied in the generator
C.O.P. maximum = Q_E / Q_G

6. What is the value of maximum C.O.P. in terms of temperature?
a) $[T_C$ â€“ $T_E / T_E] [T_G / T_G$ â€“ $T_C]$
b) $[T_C$ â€“ $T_E / T_E] [T_G / T_G$ â€“ $T_C]$
c) $[T_C$ â€“ $T_E / T_E] [T_G / T_G$ â€“ $T_C]$
d) $[T_G$ â€“ $T_C / T_G] [T_E / T_C$ â€“ $T_E]$

Answer: d
Explanation: As VAR uses the generator to do work as well as pump to pressurize the liquid to the generator. So, total work done is the summation of work done by a pump and generator. Refrigeration effect is the heat absorbed in the evaporator.
So, C.O.P. = Refrigeration effect / Total work done
= Heat absorbed in the evaporator / Work done by pump + Heat supplied in the generator
For maximum C.O.P., due to the minimal effect of work done by a pump, Q_P is neglected.
Q_E = Heat absorbed in the evaporator and Q_G = Heat supplied in generator
C.O.P. maximum = Q_E / Q_G
By using the phenomenon of perfectly reversible system,
$Q_G + Q_E / T_C = Q_G / T_G + Q_E / T_E$
Q_G / T_G â€“ $Q_G / T_C = Q_E / T_C$ â€“ Q_E / T_E
$Q_G [T_C$ â€“ $T_G / T_C \text{ x } T_G] = Q_E [T_E$ â€“ $T_C / T_C \text{ x } T_E]$
By rearranging, $Q_E / Q_G = [T_G$ â€“ $T_C / T_G] [T_E / T_C$ â€“ $T_E]$
$(C.O.P.)_{max} = Q_E / Q_G = [T_G$ â€“ $T_C / T_G] [T_E / T_C$ â€“ $T_E]$

7. Which of the following is true?
a) $(C.O.P.)_{max} = (C.O.P.)_{Carnot}$ / Î· $_{Carnot}$
b) $(C.O.P.)_{max} = (C.O.P.)_{Carnot}$ + Î· $_{Carnot}$
c) $(C.O.P.)_{max} = (C.O.P.)_{Carnot}$ x Î· $_{Carnot}$

d) $(C.O.P.)_{max}$ = $(C.O.P.)_{Carnot}$ â€“ $Î·_{Carnot}$

Answer: c
Explanation: As, $(C.O.P.)_{max}$ = Q_E / Q_G = [T_G â€“ T_C / T_G] [T_E / T_C â€“ T_E]
Where, it may be noted that, [T_E / T_C â€“ T_E] is the coefficient of performance of a Carnot refrigerator working between T_E and T_C temperatures.
And, [T_G â€“ T_C / T_G] is the efficiency of a Carnot engine working between T_G and T_C temperatures.
Hence, $(C.O.P.)_{max}$ = $(C.O.P.)_{Carnot}$ x $Î·_{Carnot}$

8. C.O.P. of the VAR system is lower than the C.O.P. of VCR system.
a) True
b) False

Answer: a
Explanation: Though the VAR system has many advantages over VCR, VAR gives lower C.O.P. as compared to VCR. Compressor used in the VCR system given higher pressure difference, which increases the temperature more and thus increasing the heat rejection. Overall impacting the C.O.P. to increase but in case of VAR system, heat supplied is limited so overall C.O.P. is not as high as in the VCR.

9. In a VAR system, heating, cooling, and refrigeration take place at temperatures 200Â°C, 30Â°C, and -10Â°C respectively. What is the value of maximum C.O.P. of the system?
a) 2.202
b) 2.808
c) 3.404
d) 2.404

Answer: d
Explanation: Given: T_G = 200Â°C = 200 + 273 = 473 K
T_C = 30Â°C = 273 + 30 = 303 K
T_E = â€“ 10Â°C = 273 â€“ 10 = 263 K
As, $(C.O.P.)_{max}$ = Q_E / Q_G = [T_G â€“ T_C / T_G] [T_E / T_C â€“ T_E]
= [263 / 303 â€“ 263] [473 â€“ 303 / 473]
= [263/ 40] [173 / 473]
= [45499 / 18920]
= 2.404.

10. What is the value of maximum C.O.P. if the VAR system has a capacity of 12 TR and heat given to the refrigerant in the generator is 40 kW?
a) 0.9523
b) 0.4878
c) 1.05
d) 2.05

Answer: c
Explanation: Given: Q_E = 12 TR = 12 x 3.5 = 42 kW
Q_G = 40 kW
As, C.O.P. maximum = Q_E / Q_G
= 42 / 40
= 1.05.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œDomestic Electrolux and Lithium Bromide Refrigeration System â€“ 1â€�.

1. Which one of the refrigerant is not used in the domestic Electrolux?
a) Ammonia
b) Water
c) Hydrogen
d) Freon â€“ 12

Answer: d
Explanation: The ammonia is used as a refrigerant because it possesses most of the desirable properties. It is toxic, but due to the absence of moving parts, there is very little chance for leakage and the total amount used is also

small. The hydrogen, being the lightest gas, is used to increase the rate of evaporation of the liquid ammonia passing through the evaporator.

2. What is water used for in the Domestic Electrolux?
a) Water is used to absorb hydrogen
b) Water is used to absorb ammonia
c) Water is used as a lubricant
d) Water is used to keep the inner surface clean

Answer: b
Explanation: The function of water is used as a solvent as it has the ability to absorb ammonia readily. The hydrogen is also non â€“ corrosive and insoluble in water.

3. The Domestic absorption type refrigerator was invented by?
a) Carl Munters
b) Baltzer Von Platan
c) Carl Munters and Baltzer Von Platan
d) Light Foot

Answer: c
Explanation: The Domestic absorption type refrigerator was invented by two Swedish engineers, Carl Munters and Baltzer Von Platan, in 1925 while they were studying for their undergraduate course of Royal Institute of Technology in Stockholm. Whereas Light foot invented the Bell â€“ Coleman cycle.

4. The Domestic Electrolux cannot be used for industrial purposes.
a) True
b) False

Answer: a
Explanation: The Domestic Electrolux cannot be used for industrial purposes as the COP of the system is very low. The whole cycle is carried out entirely by the gravity flow of the refrigerant.

5. Find the COP of the domestic Electrolux system when the heat supplied in the generator (Q_G) is 1885 KJ/kg and the heat absorbed in the evaporator (Q_e) is 1045 KJ/kg.
a) 0.4
b) 0.45
c) 0.55
d) 0.65

Answer: c
Explanation: The COP of the domestic Electrolux system is the ratio of the heat absorbed by the evaporator and the heat supplied by the evaporator.
COP = $\frac{1045}{1885}$ = 0.554.

6. Which of the refrigerant is used as a refrigerant in Lithium Bromide Absorption Refrigeration system?
a) Ammonia
b) Water
c) Hydrogen
d) Lithium Bromide

Answer: b
Explanation: Water is used as a refrigerant in Lithium Bromide Absorption Refrigeration system whereas lithium bromide, which is highly hydroscopic salt, is used as an absorbent. Lithium Chromate is used a corrosion inhibitor.

7. In lithium bromide absorption refrigeration system it is not necessary to keep the refrigeration temperature above 0Â°C.
a) True
b) False

Answer: b
Explanation: In lithium bromide absorption refrigeration system it is necessary to keep the refrigeration temperature above 0Â°C as it is the freezing point of water. Water is used as a refrigerant in the system.

8. Find the COP of the lithium bromide absorption system when the heat supplied in the generator (Q_G) is 1255 KJ/kg and the heat absorbed in the evaporator (Q_e) is 955 KJ/kg.
a) 0.66
b) 0.75

c) 0.85
d) 0.76

Answer: d
Explanation: The COP of the lithium bromide absorption refrigeration system is the ratio of the heat absorbed by the evaporator and the heat supplied by the evaporator.
COP = \(\frac{955}{1255}\) = 0.76.

9. Find the relative COP of the system whose maximum COP is 2.0 and the actual COP is 0.8.
a) 0.5
b) 0.4
c) 0.3
d) 0.6

Answer: b
Explanation: The relative COP is the ratio of actual COP and the maximum COP of the system,
Relative COP = (Actual COP) / (Maximum COP)
= \(\frac{0.8}{2.0}\) = 0.4.

This set of Refrigeration Question Paper focuses on â€œDomestic Electrolux and Lithium Bromide Refrigeration System â€“ 2â€�.

1. What is the key difference between a simple VAR and Electrolux refrigerator?
a) Absorber
b) Liquid pump
c) Working mechanism
d) Generator

Answer: b
Explanation: Simple VAR uses a generator to do work as well as a pump to pressurize the liquid to the generator. So, total work done is the summation of work done by a pump and generator. Refrigeration effect is the heat absorbed in the evaporator. But as in the case of Electrolux refrigerator pump is not present. It is the VAR system with no liquid pump; hence, it is the key difference between Simple VAR and Electrolux refrigerator.

2. What is the other name for Electrolux refrigerator?
a) Single-fluid absorption system
b) Two-fluid absorption system
c) Three-fluid absorption system
d) Four-fluid absorption system

Answer: c
Explanation: Electrolux refrigerator uses Ammonia, Hydrogen, and Water to carry out the desired effect. As three fluids are used for the operation, Electrolux refrigerator is also called a Three-fluid absorption system.

3. Which of the following is valid for one of the processes in the Electrolux refrigerator?
a) Ammonia evaporates in hydrogen
b) Hydrogen evaporates in ammonia
c) Water evaporates in hydrogen
d) Ammonia evaporates in water

Answer: a
Explanation: According to Daltonâ€™s principle, the hydrogen entering the evaporator allows the liquid ammonia to evaporate at low pressure and temperature. Evaporated ammonia absorbs latent heat and produces refrigeration effect.

4. What are the fluids used in the Electrolux refrigerator?
a) Hydrogen, Water
b) Hydrogen, Water, Lithium
c) Hydrogen, Water, Bromide
d) Hydrogen, Water, Ammonia

Answer: d
Explanation: Electrolux refrigerator uses Ammonia, Hydrogen, and Water to carry out the desired effect. As three fluids are used for the operation, Electrolux refrigerator is also called a Three-fluid absorption system.

5. What is the purpose of using Hydrogen in Electrolux refrigerator?
a) To increase the vapour pressure of ammonia
b) To increase the rate of evaporation

c) To decrease the rate of evaporation
d) To get evaporated by using ammonia

Answer: b
Explanation: Hydrogen is light, non-corrosive, and insoluble in water. Hydrogen being light, used for increasing the rate of evaporation. As lighter the gas, faster is the evaporation process. Hence hydrogen is used on the low-pressure side of the system to allow faster evaporation of ammonia.

6. What is the role of water in the Electrolux refrigerator?
a) Solvent
b) Evaporation rate enhancer
c) Evaporation rate reducer
d) Refrigerant

Answer: a
Explanation: Water is used as a solvent in Electrolux refrigerator due to the nature of readily absorbing the refrigerant i.e., ammonia.

7. What is the value of C.O.P. in the Electrolux refrigerator?
a) Q_G / Q_E
b) Q_E / Q_G
c) Q_G / Q_C
d) Q_C / Q_E

Answer: b
Explanation: As VAR uses the generator to do work as well as pump to pressurize the liquid to the generator. So, total work done is the summation of work done by a pump and generator. Refrigeration effect is the heat absorbed in the evaporator. But in the case of Electrolux refrigerator, a liquid pump is not used so $Q_P = 0$.

So, C.O.P. = Refrigeration effect / Total work done
= Heat absorbed in the evaporator / Work done by pump + Heat supplied in the generator
Q_E = Heat absorbed in the evaporator and Q_G = Heat supplied in the generator
C.O.P. = Q_E / Q_G

8. Which refrigerants are used in Electrolux and Li-Br water refrigeration system?
a) Ammonia and Lithium
b) Water and Water
c) Water and Bromide
d) Ammonia and Water

Answer: d
Explanation: In the Electrolux refrigerator, ammonia is used as a refrigerant, and in the case of Li-Br water system water is used as a refrigerant due to their desirable properties to produce refrigeration effect.

9. In Li-Br water system, Water is used as an absorber and Li-Br solution as a refrigerant.
a) False
b) True

Answer: a
Explanation: In Li-Br water system, water is used as a refrigerant and Li-Br solution as an absorber due to its strong affinity for water vapour.

10. Which of the following nature of Li-Br solution leads to the usage of inhibitors?
a) Toxic
b) Corrosive
c) Strong affinity for water vapour
d) Low boiling point

Answer: b
Explanation: Due to the corrosive nature of Li-Br solution, inhibitors are added to protect the metal parts. Often used corrosion inhibitor is Lithium chromate.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œMultiple Evaporators and Compressor System â€“ 1â€�.

1. Multiple evaporator system is used to maintain different temperatures at different points.
a) False
b) True

Answer: b
Explanation: Multiple evaporator system is used to maintain different temperatures at a different point as per the specific requirements. For example, fresh fruits and fresh vegetables need to be stored in optimum temperatures and frozen products, dairy products to be stored at different optimum temperatures; for such cases, multiple evaporator system is beneficial.

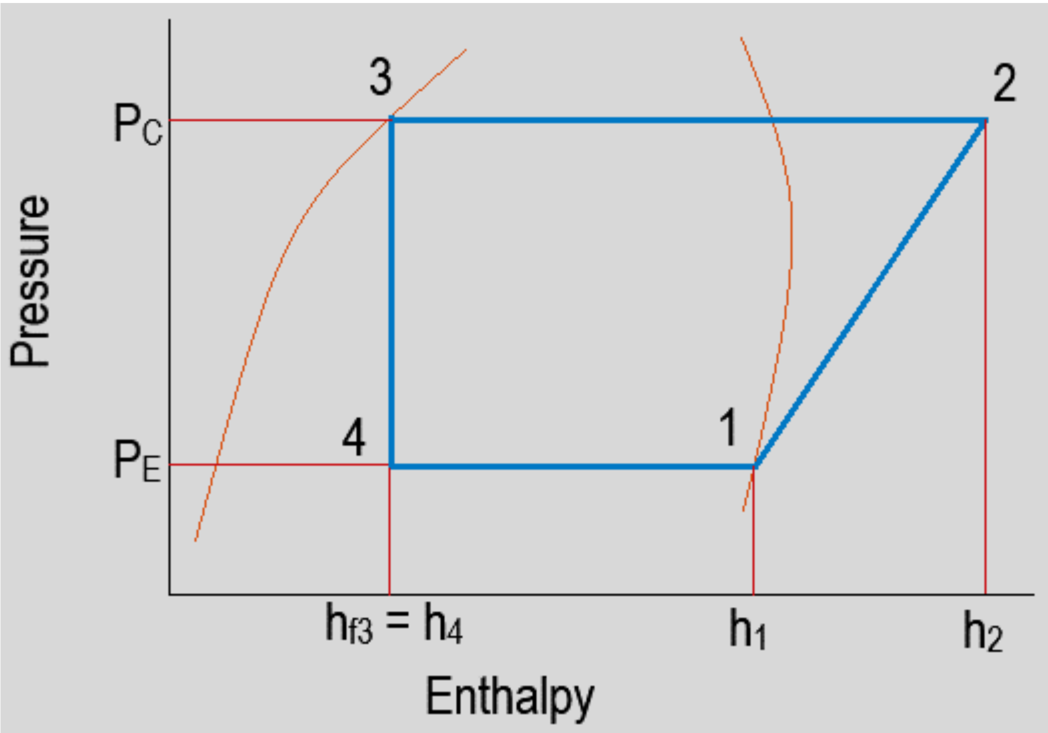
2. Vegetables, Fruits, Frozen products can be maintained at the same temperatures and humidity.
a) False
b) True

Answer: a
Explanation: Multiple evaporator system is used to maintain different temperatures at a different point as per the specific requirements. For example, fresh fruits and fresh vegetables need to be stored in optimum temperatures and frozen products, dairy products to be stored at different optimum temperatures; for such cases, multiple evaporator system is beneficial. Hence, these different products cannot be maintained at the same temperatures and humidity; otherwise, it will lead to ruining of the products.

3. Which of the following system is used for maintaining at the same temperatures when food products kept in different compartments?
a) Evaporator at the same temperature with a single compressor
b) Evaporator at the same temperature with multiple compressors
c) Evaporator at different temperature with a single compressor
d) Evaporator at different temperature with multiple compressors

Answer: a
Explanation: For the given case, Multiple evaporators at the same temperatures with a single compressor and expansion valve is used. Though food products are kept in different compartments, the temperatures to be maintained is the same. Hence, this arrangement gives the effective output.

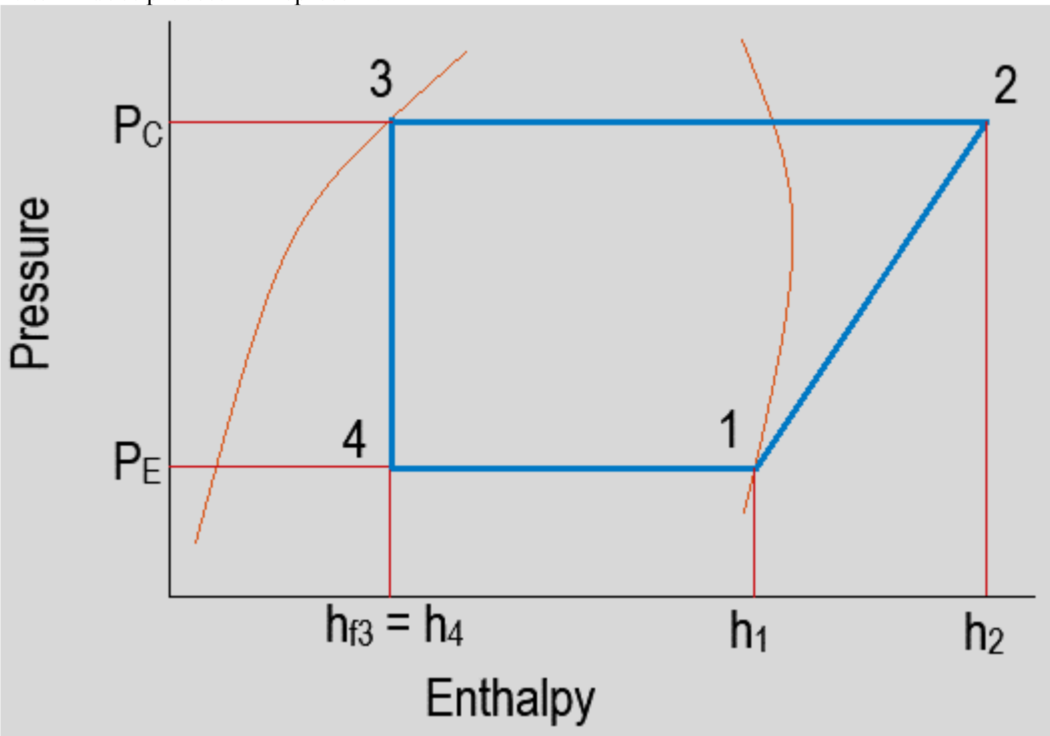
4. What do P_C and P_E represent?



a) Evaporator and expansion pressure
b) Compression and expansion pressure
c) Condenser and evaporator pressure
d) Intercooling pressure

Answer: c
Explanation: P_C is for condenser pressure. The pressure at which latent heat is rejected from the refrigerant and converting vapor form to liquid form. P_E is for evaporator pressure. The pressure at which latent heat of vaporization is absorbed from the medium and phase change from liquid to vapor is carried out. Attaining and maintaining these pressures is essential for the smooth operation of the cycle.

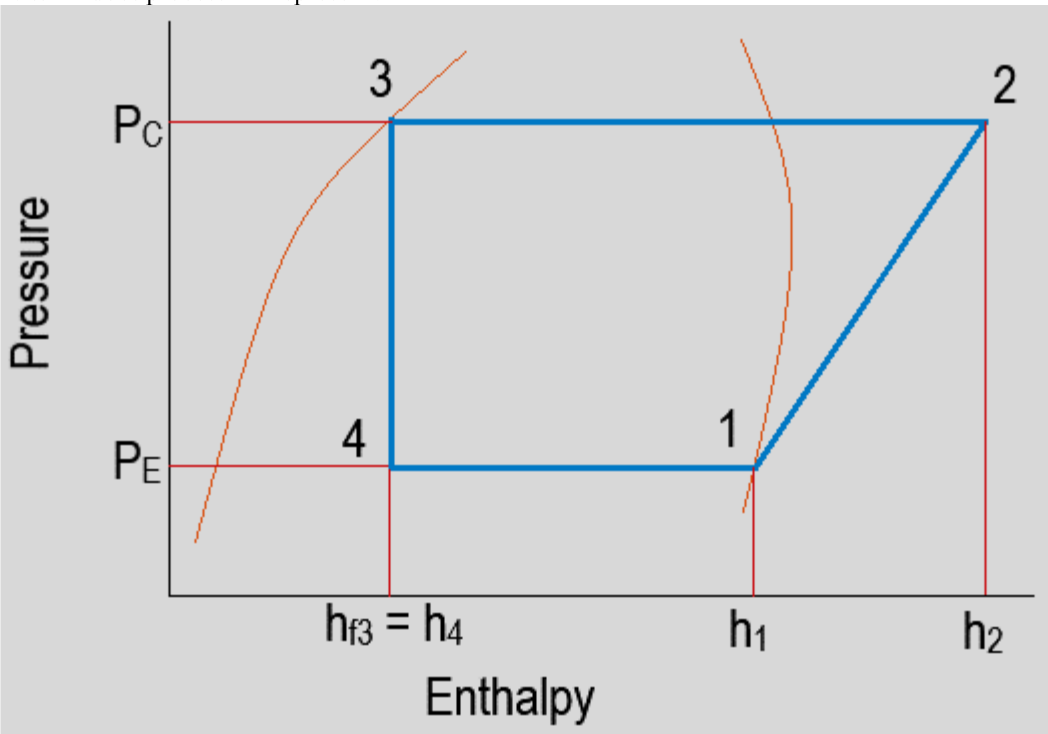
5. What does process 1-2 represent?



a) Evaporation
b) Compression
c) Condensation
d) Expansion

Answer: b
Explanation: Process 1-2 represent compression. This type of compression is isentropic compression, which is carried out in the compressor, and pressure is enhanced from P_E to P_C.

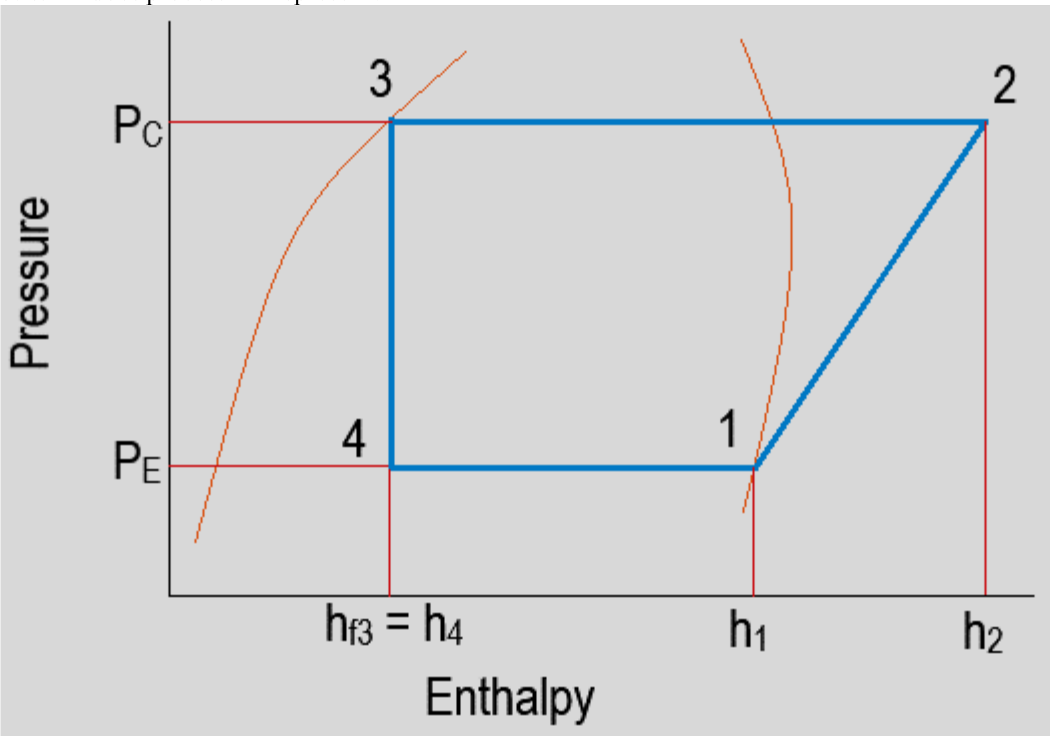
6. What does process 2-3 represent?



a) Evaporation
b) Compression
c) Condensation
d) Expansion

Answer: c
Explanation: Process 2-3 represent condensation. This process results in the phase change of refrigerant from superheated vapor to liquid form at the condenser pressure.

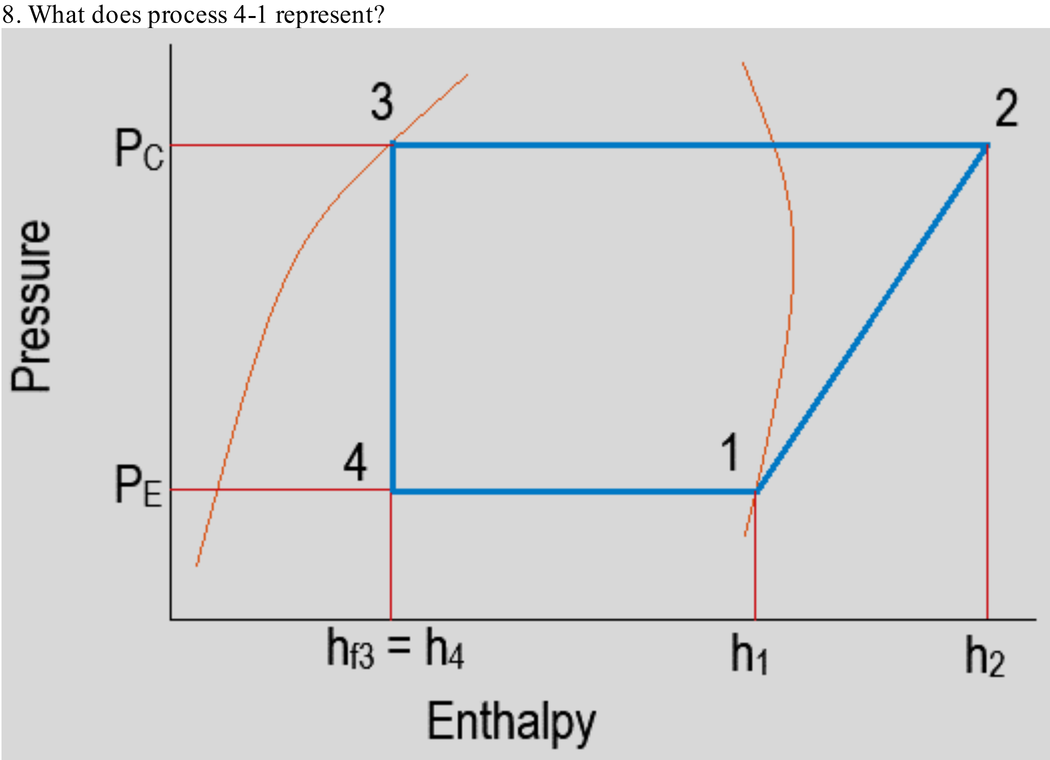
7. What does process 2-3 represent?



a) Evaporation
b) Compression
c) Condensation
d) Expansion

Answer: d
Explanation: Process 3-4 represent expansion. This process results in expanding the liquid refrigerant from condenser pressure to evaporative pressure.

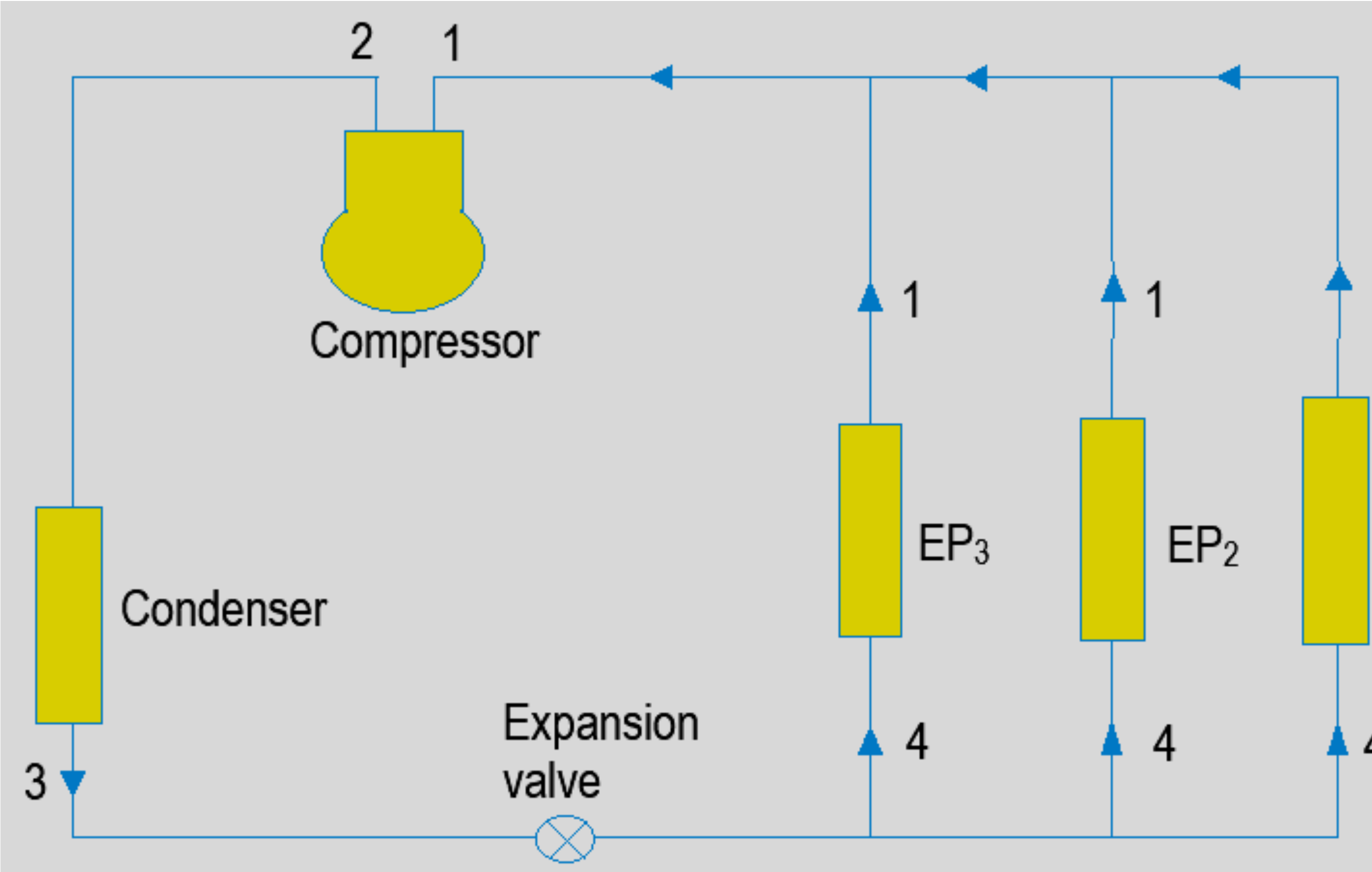
8. What does process 4-1 represent?



a) Evaporation
b) Compression
c) Condensation
d) Expansion

Answer: a
Explanation: Process 4-1 represent evaporation. This process results in a phase change of refrigerant from liquid to vapor form at the evaporator pressure. Multiple evaporators at the same temperatures are used. Evaporation process gives the refrigeration effect.

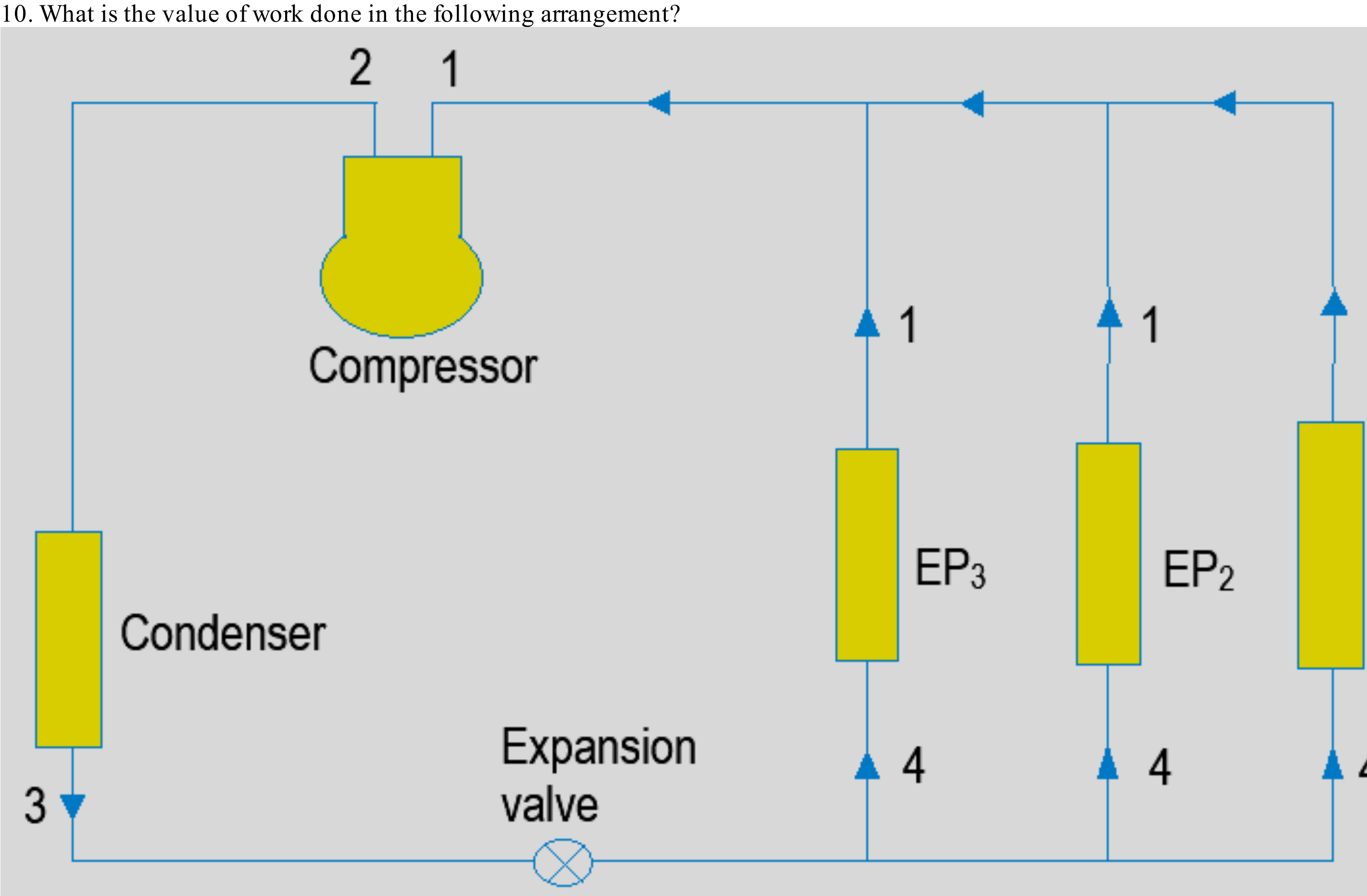
9. What is the total mass of refrigerant flowing through the compressor if the masses flowing through each evaporator are m_1, m_2, and m_3?



a) m_1 â€“ m_2 â€“ m_3
b) $m_1 + m_2$ â€“ m_3
c) m_1 â€“ $m_2 + m_3$
d) $m_1 + m_2 + m_3$

Answer: d
Explanation: m_1 is the mass flowing through EP_1 i.e. first evaporator, which is given by 210 Q_1 / h_1 â€“ h_4
m_2 is the mass flowing through EP_2 i.e., the second evaporator, which is given by 210 Q_2 / h_1 â€“ h_4
m_3 is the mass flowing through EP_3 i.e., the third evaporator, which is given by 210 Q_3 / h_1 â€“ h_4
As the evaporators are connected in such a way that masses get converged and then enter into the compressor.
So, mass flowing through the compressor will be the summation of masses flowing through each evaporator.
Mass of refrigerant flowing through compressor, $m = m_1 + m_2 + m_3$.

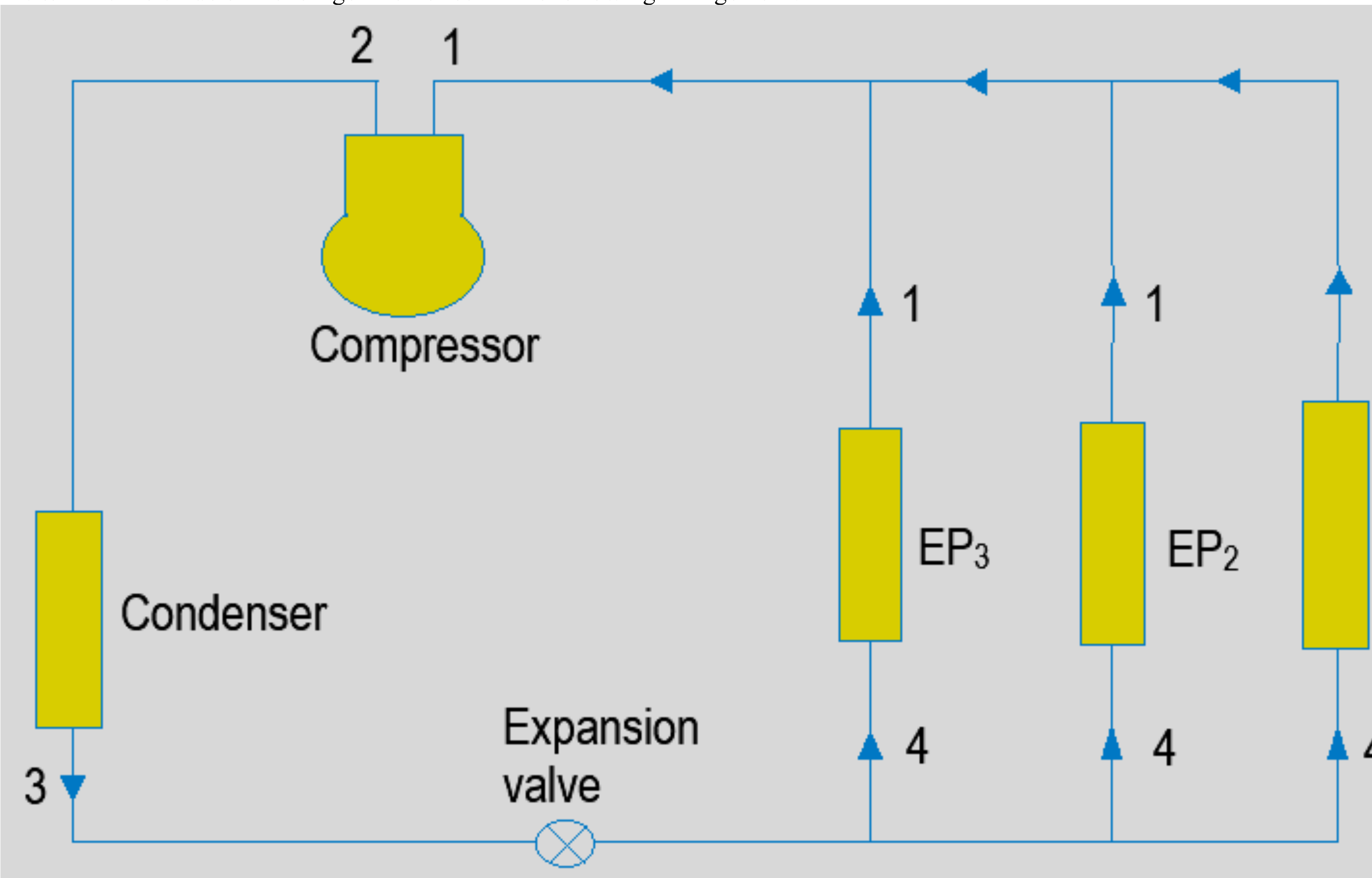
10. What is the value of work done in the following arrangement?



a) m_1 â€“ m_2 â€“ m_3 (h_2 â€“ h_1)
b) $m_1 + m_2 + m_3$ (h_2 â€“ h_1)
c) $m_1 + m_2$ â€“ m_3 (h_2 â€“ h_1)
d) $m_1 + m_2 + m_3$ (h_4 â€“ h_1)

Answer: b
Explanation: m_1 is the mass flowing through EP $_1$ i.e. first evaporator, which is given by 210 Q_1 / h_1 â€“ h_4
m_2 is the mass flowing through EP $_2$ i.e., the second evaporator, which is given by 210 Q_2 / h_1 â€“ h_4
m_3 is the mass flowing through EP $_3$ i.e., the third evaporator, which is given by 210 Q_3 / h_1 â€“ h_4
As the evaporators are connected in such a way that masses get converged and then enter into the compressor. So, mass flowing through the compressor will be the summation of masses flowing through each evaporator.
Mass of refrigerant flowing through compressor, $m = m_1 + m_2 + m_3$
The enthalpy change across the compressor is h_1 and h_2 .
Work done = mass of refrigerant flowing through the compressor x enthalpy change across the compressor.
= $m_1 + m_2 + m_3$ (h_2 â€“ h_1).

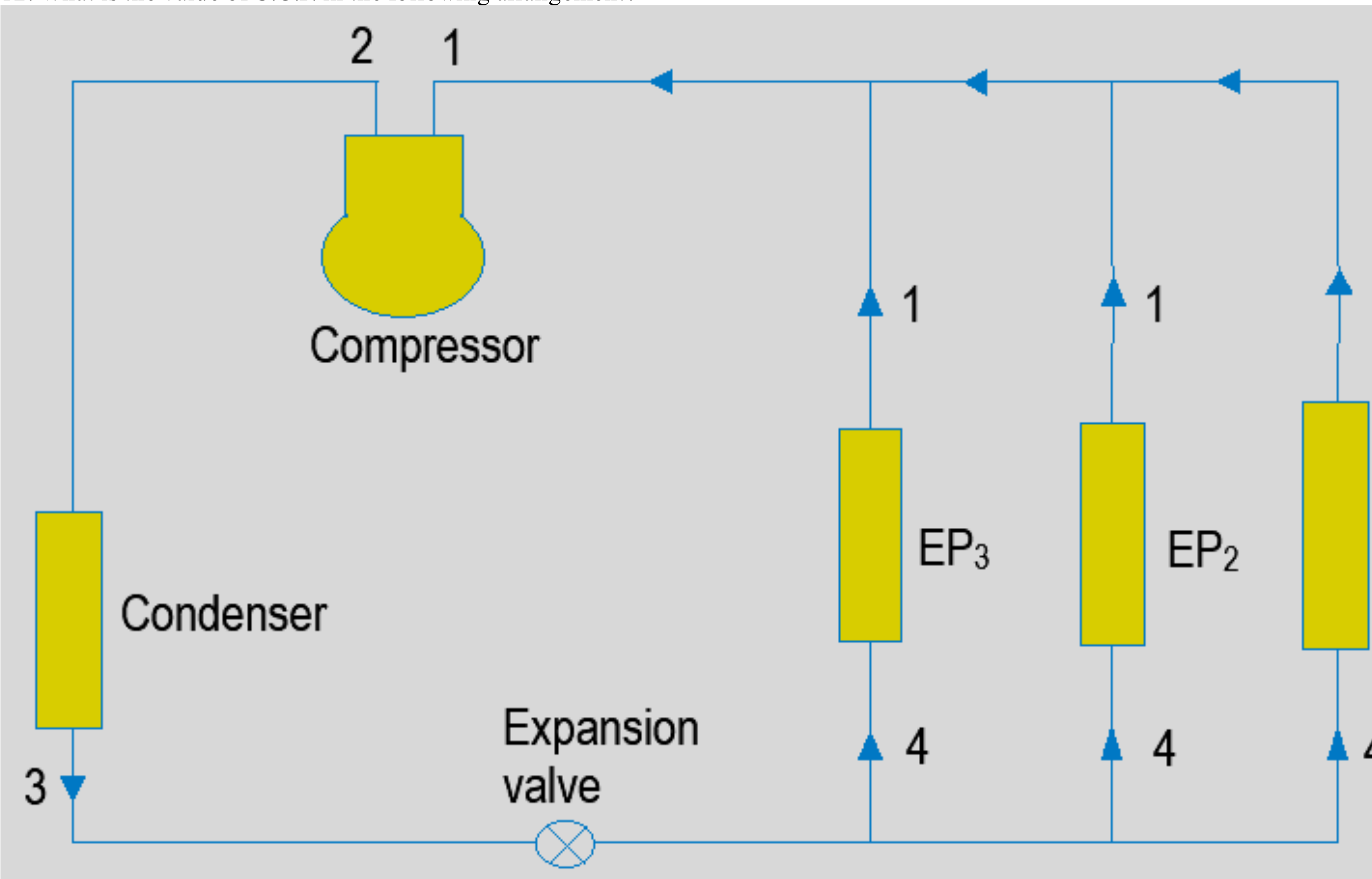
11. What is the value of the refrigeration effect in the following arrangement?



a) m_1 â€“ m_2 â€“ m_3 (h_2 â€“ h_1)
b) m_1 + m_2 + m_3 (h_4 â€“ h_1)
c) m_1 + m_2 + m_3 (h_1 â€“ h_4)
d) m_1 + m_2 â€“ m_3 (h_4 â€“ h_1)

Answer: c
Explanation: m_1 is the mass flowing through EP_1 i.e. first evaporator, which is given by 210 Q_1 / h_1 â€“ h_4
m_2 is the mass flowing through EP_2 i.e., the second evaporator, which is given by 210 Q_2 / h_1 â€“ h_4
m_3 is the mass flowing through EP_3 i.e., the third evaporator, which is given by 210 Q_3 / h_1 â€“ h_4
As the evaporators are connected in such a way that masses get converged and then enter into the compressor.
Total mass of refrigerant flowing through the evaporator, $m = m_1 + m_2 + m_3$
The enthalpy change across the evaporator is h_1 and h_4.
Total Refrigeration effect = Total mass of refrigerant flowing through the evaporator x enthalpy change across the evaporator
$= m_1 + m_2 + m_3 (h_1$ â€“ $h_4)$.

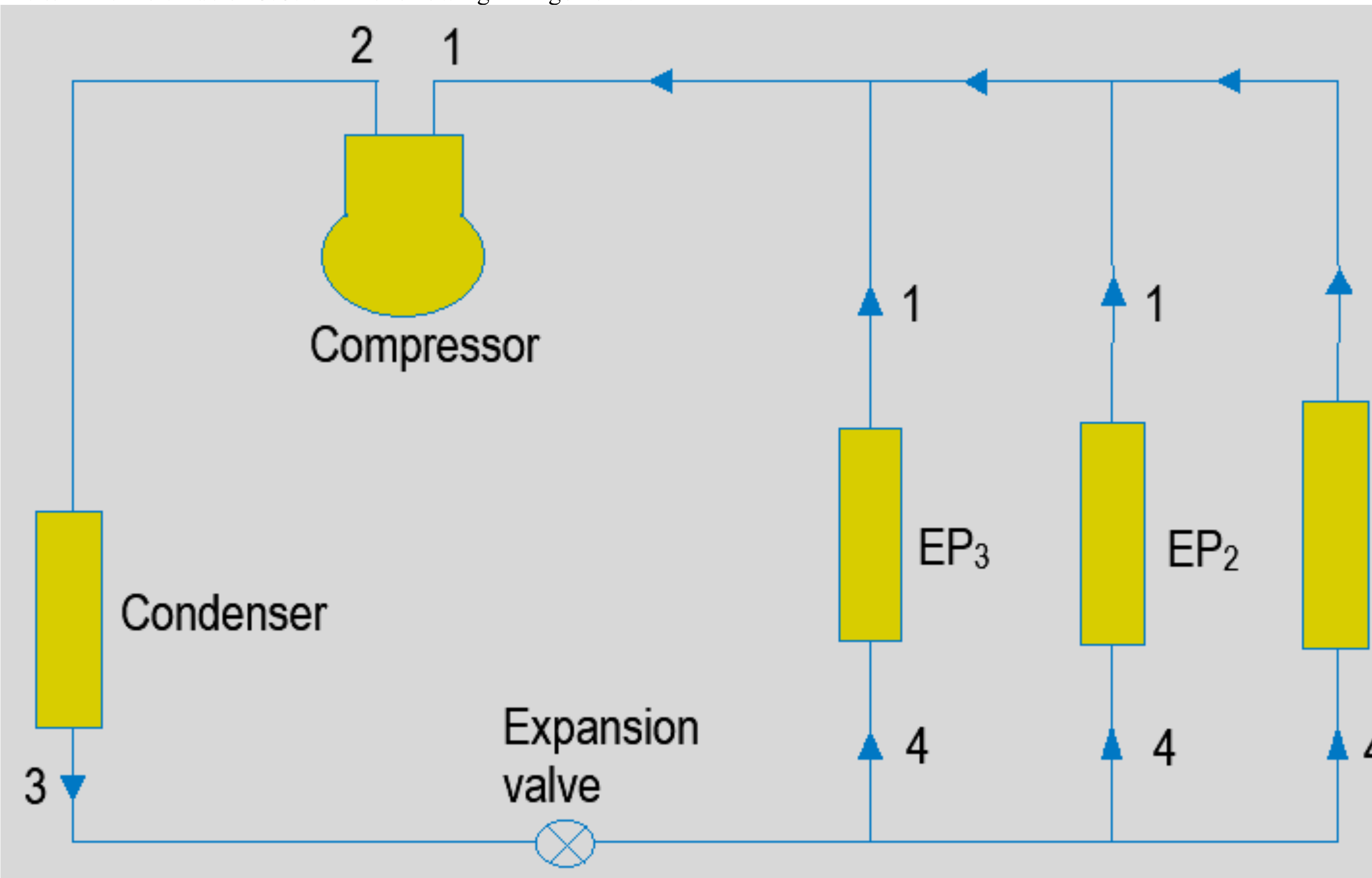
12. What is the value of C.O.P. in the following arrangement?

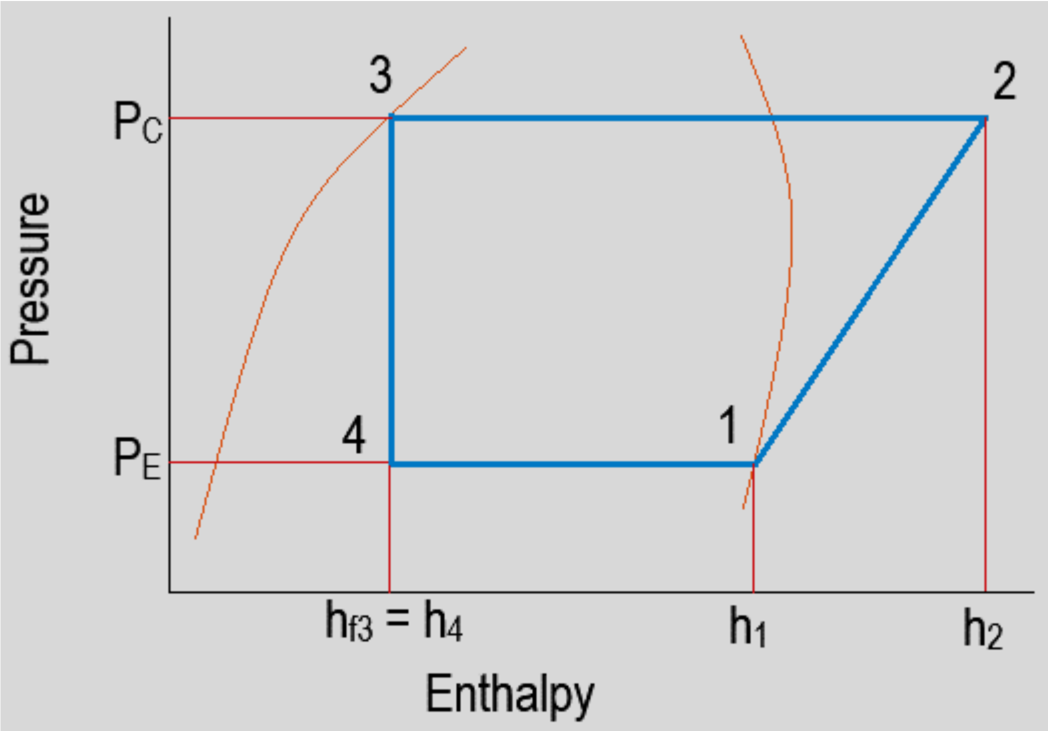


a) (h_1 â€“ h_4) / (h_2 â€“ h_1)
b) (h_1 â€“ h_4) / (h_4 â€“ h_1)
c) (h_1 â€“ h_2) / (h_4 â€“ h_1)
d) (h_2 â€“ h_3) / (h_2 â€“ h_1)

Answer: a
Explanation: m_1 is the mass flowing through EP_1 i.e. first evaporator, which is given by 210 Q_1 / h_1 â€“ h_4
m_2 is the mass flowing through EP_2 i.e., the second evaporator, which is given by 210 Q_2 / h_1 â€“ h_4
m_3 is the mass flowing through EP_3 i.e., the third evaporator, which is given by 210 Q_3 / h_1 â€“ h_4
As the evaporators are connected in such a way that masses get converged and then enter into the compressor.
Total mass of refrigerant flowing through the evaporator, $m = m_1 + m_2 + m_3$
The enthalpy change across the evaporator is h_1 and h_4.
Total Refrigeration effect = Total mass of refrigerant flowing through the evaporator x enthalpy change across the evaporator
= $m_1 + m_2 + m_3$ (h_1 â€“ h_4)
So, mass flowing through the compressor will be the summation of masses flowing through each evaporator.
Mass of refrigerant flowing through compressor, $m = m_1 + m_2 + m_3$
The enthalpy change across the compressor is h_1 and h_2.
Work done = mass of refrigerant flowing through the compressor x enthalpy change across the compressor.
= $m_1 + m_2 + m_3$ (h_2 â€“ h_1)
So, C.O.P. = Total Refrigeration effect / Work done
= ($m_1 + m_2 + m_3$) (h_1 â€“ h_4) / ($m_1 + m_2 + m_3$) (h_2 â€“ h_1)
= (h_1 â€“ h_4) / (h_2 â€“ h_1).

13. What is the value of C.O.P. in the following arrangement?





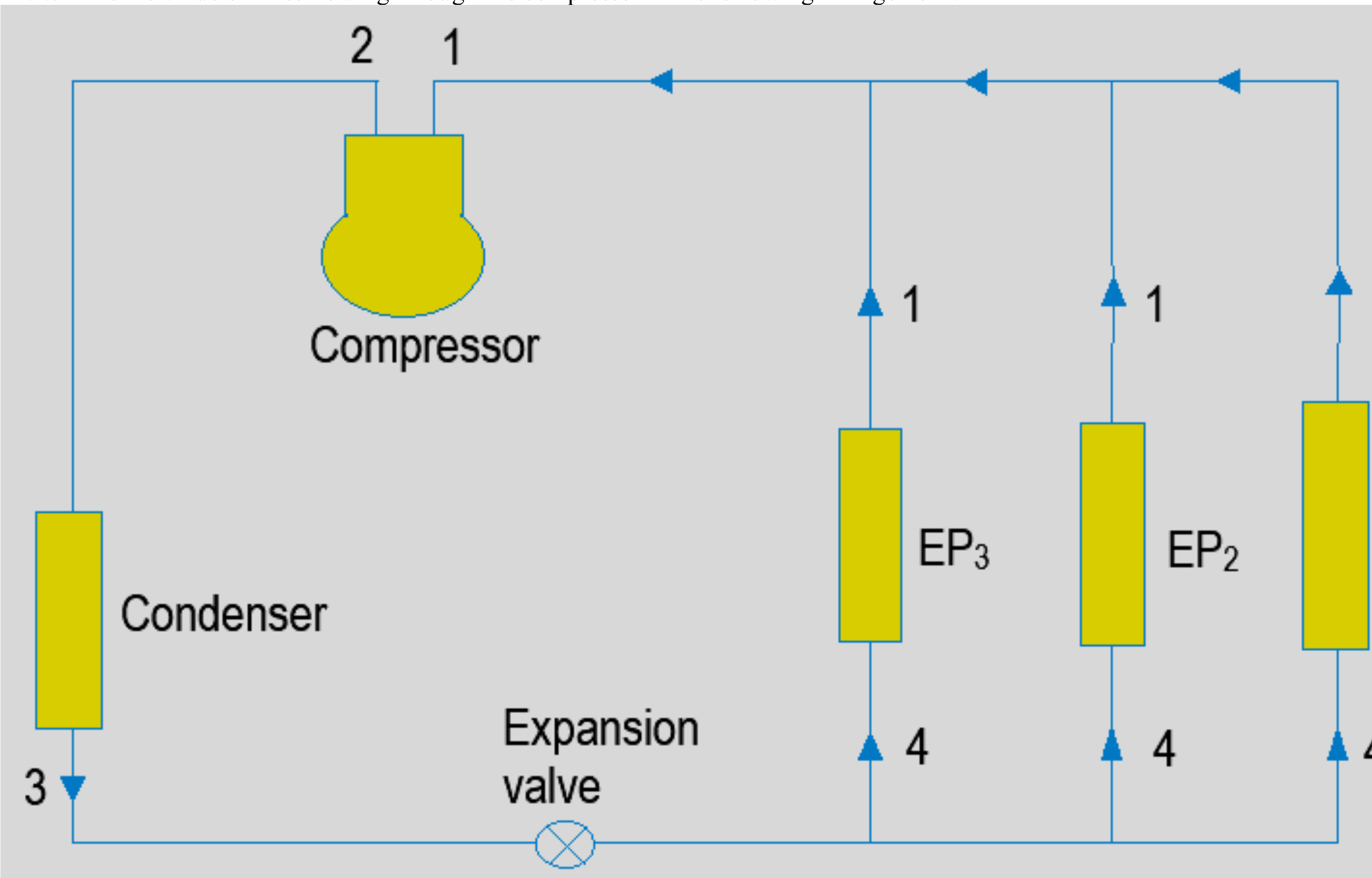
If the values of enthalpy at point 1, 2 and 3 are 184, 210 and 75 kJ/kg and masses are m_1 = 13 kg/min, m_2 = 15 kg/min and m_3 = 28.085 kg/min

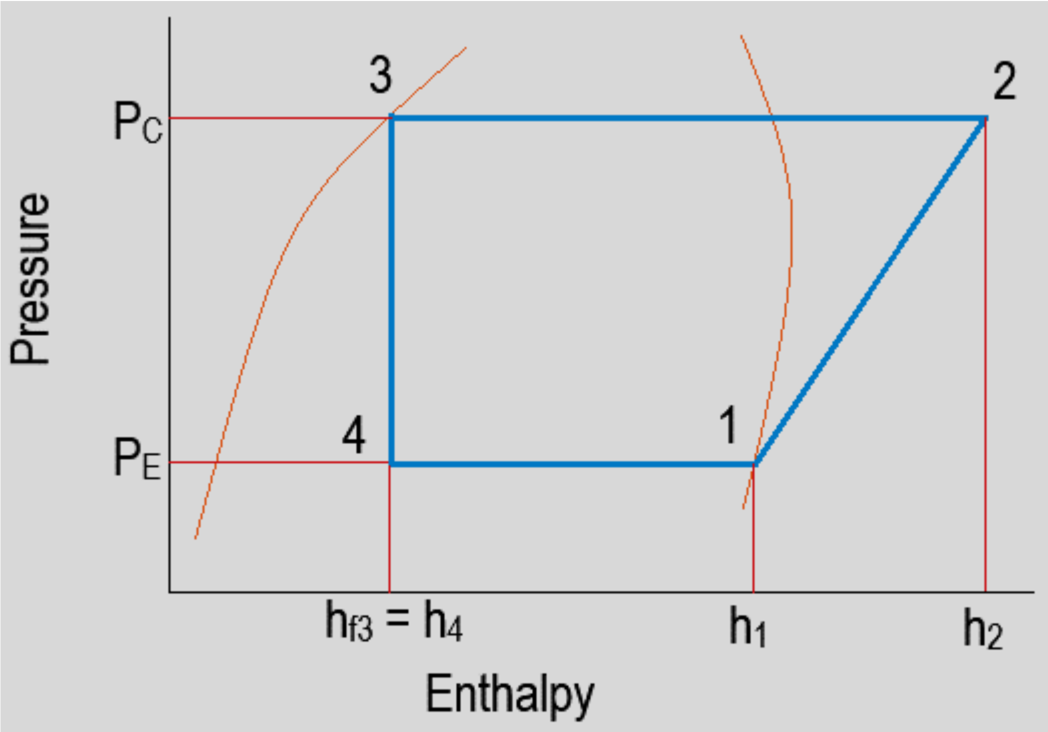
a) 6.23
b) 1.88
c) 4.19
d) 0.2386

Answer: c
Explanation: Given: h_1 = 184 kJ/kg, h_2 = 210 kJ/kg and h_3 = h_4 = 75 kJ/kg
Though masses are given but for work done and refrigeration effect, summation is same. So, it is a redundant data.

C.O.P. = R.E. / Work done
= (h_1 â€“ h_4) / (h_2 â€“ h_1)
= (184 â€“ 75) / (210 â€“ 184)
= 109 / 26
= 4.19.

14. What is the value of mass flowing through the compressor in the following arrangement?





If the values of enthalpy at point 1, 2 and 3 are 184, 210 and 84 kJ/kg and refrigeration capacities are 10, 15 and 20 TR respectively.
a) 94.5 kg/min
b) 32.6 kg/min
c) 49.5 kg/s
d) 94.5 kg/s

Answer: a
Explanation: Given: $h_1 = 184$ kJ/kg, $h_2 = 210$ kJ/kg and $h_3 = h_4 = 84$ kJ/kg
$Q_1 = 10$ TR, $Q_2 = 15$ TR and $Q_3 = 20$ TR

As we know, $m = 210\ Q / (h_1$ â€“ $h_4)$

m_1 is the mass flowing through EP_1 i.e. first evaporator, which is given by $210\ Q_1 / h_1$ â€“ h_4,

$m_1 = 210 \times 10 / (184$ â€“ $84) = 2100 / 100 = 21$ kg/min

m_2 is the mass flowing through EP_2 i.e. second evaporator, which is given by $210\ Q_2 / h_1$ â€“ h_4,

$m_2 = 210 \times 15 / (184$ â€“ $84) = 3150 / 100 = 31.5$ kg/min

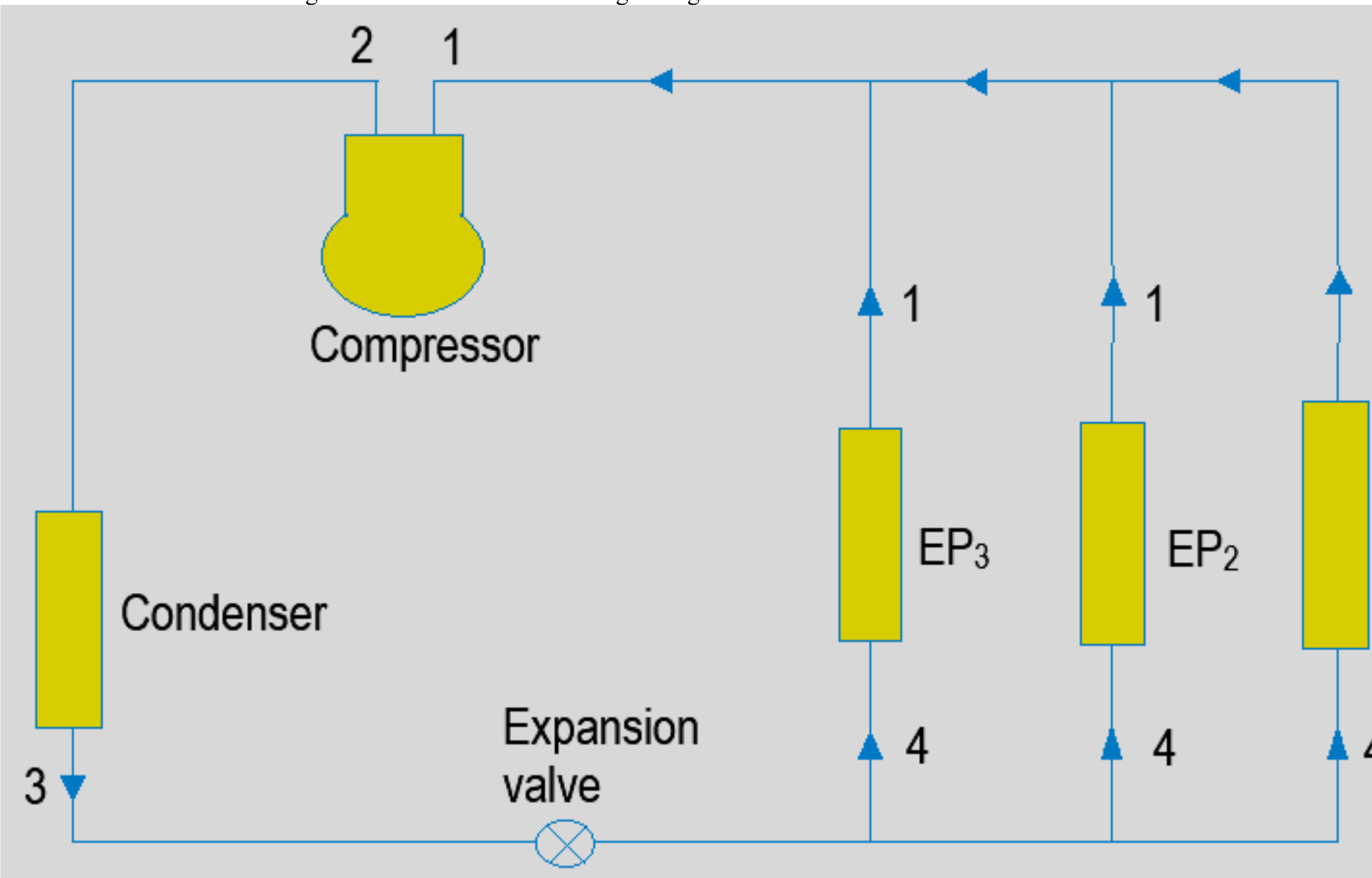
m_3 is the mass flowing through EP_3 i.e., the third evaporator, which is given by $210\ Q_3 / h_1$ â€“ h_4,

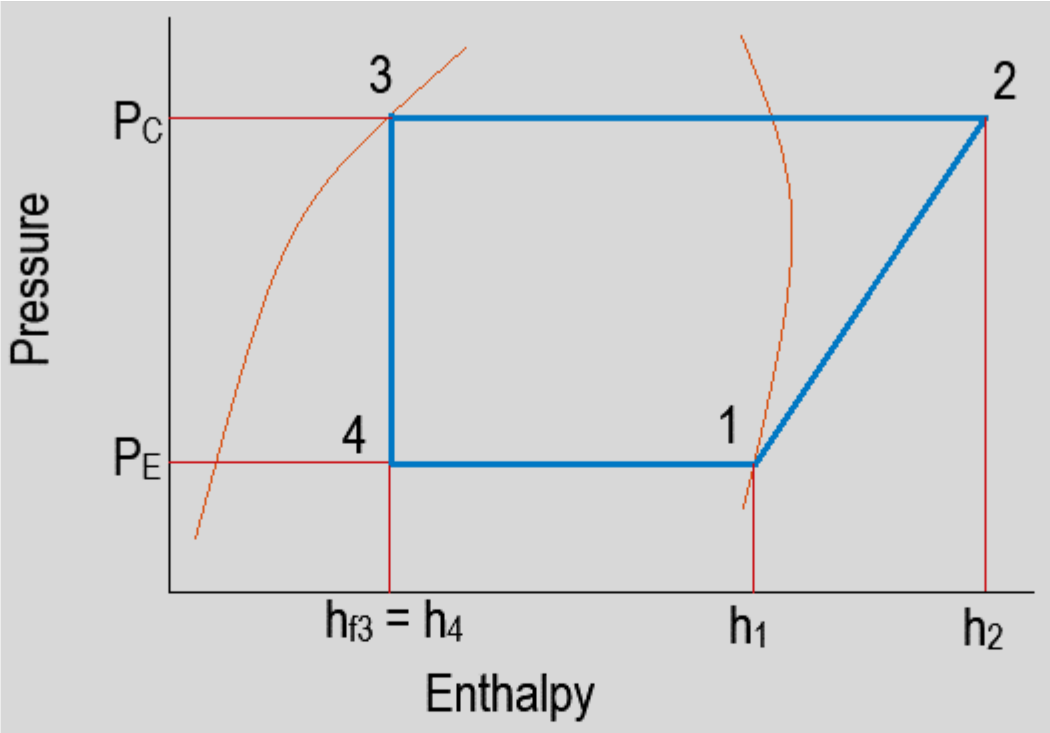
$m_3 = 210 \times 20 / (184$ â€“ $84) = 4200 / 100 = 42$ kg/min

So, mass flowing through the compressor will be the summation of masses flowing through each evaporator.
Mass of refrigerant flowing through compressor, $m = m_1 + m_2 + m_3$

$m = 21 + 31.5 + 42 = 94.5$ kg/min.

15. What is the value of Refrigeration effect in the following arrangement?





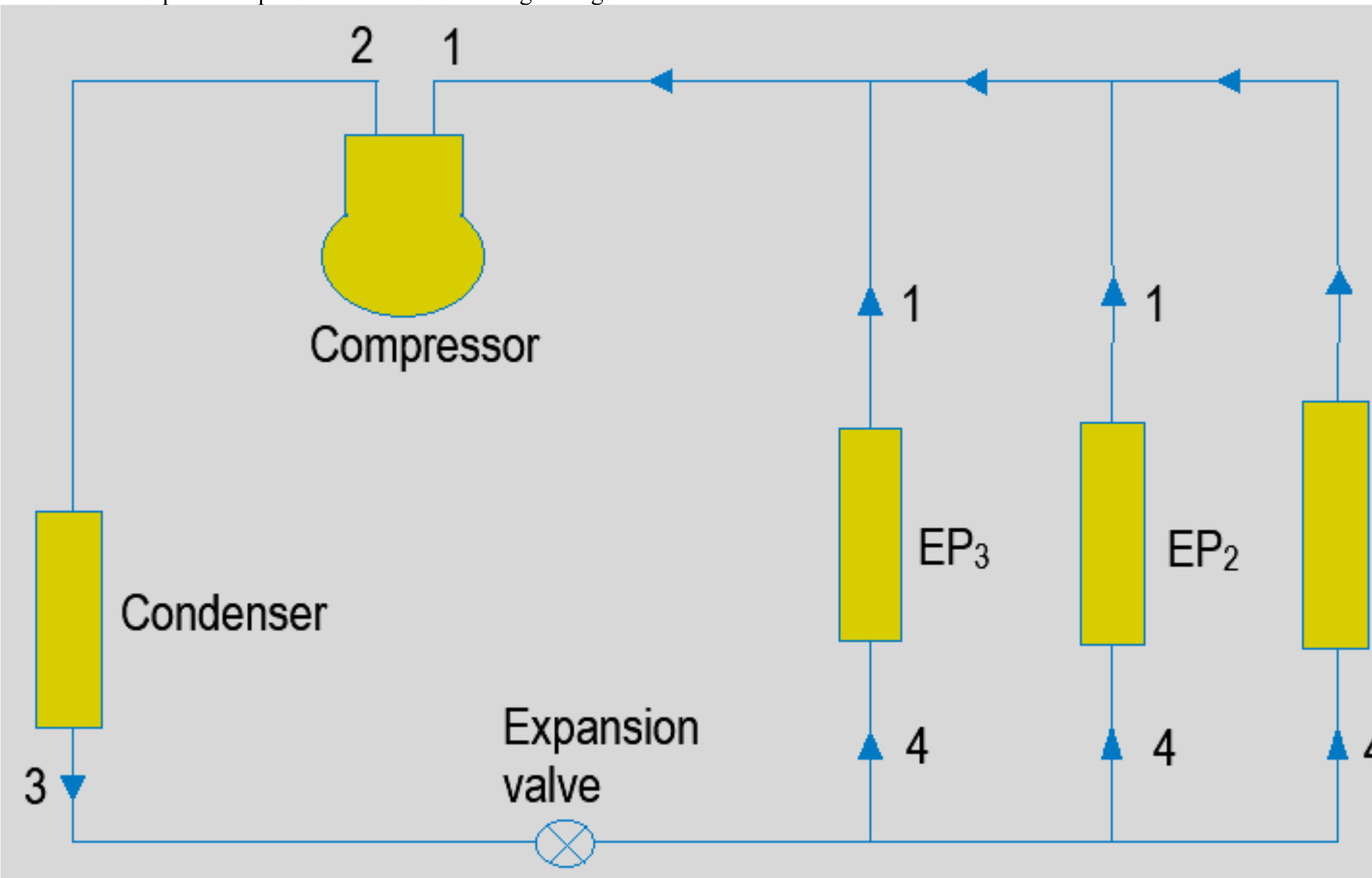
If the values of enthalpy at point 1, 2 and 3 are 170, 240 and 107 kJ/kg and masses are m_1 = 13 kg/min, m_2 = 15 kg/min and m_3 = 19 kg/min

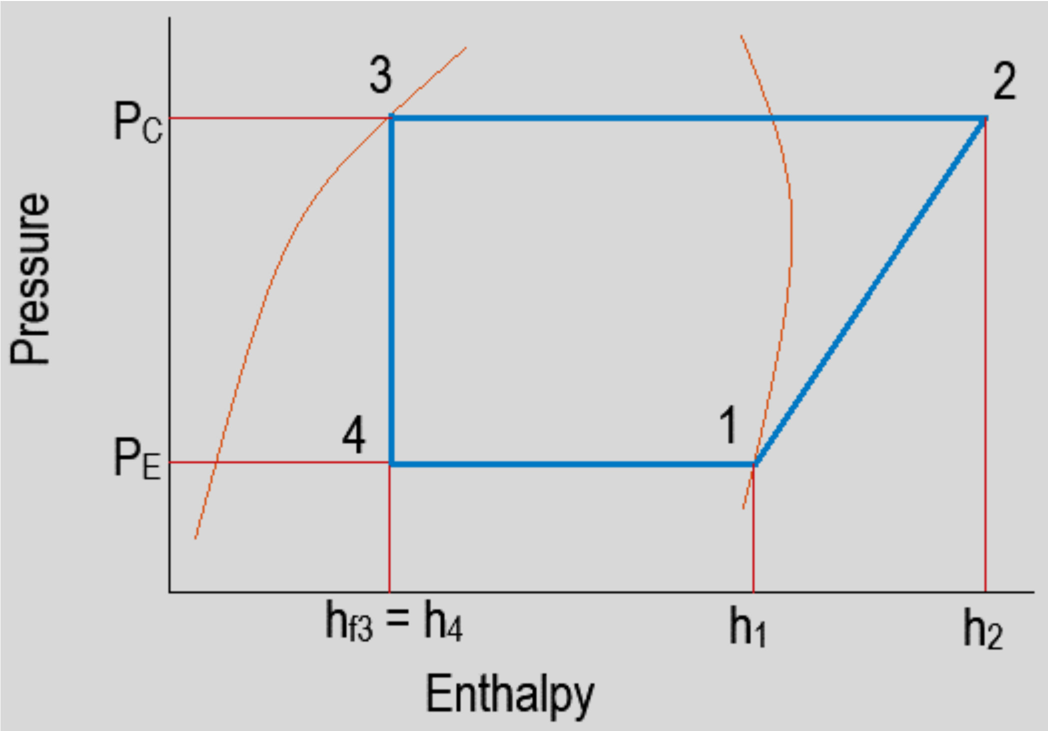
a) 3000 kJ/min
b) 2961 kW
c) 2861 kW
d) 2961 kJ/min

Answer: d
Explanation: Given: h_1 = 170 kJ/kg, h_2 = 240 kJ/kg and h_3 = h_4 = 107 kJ/kg

Total mass of refrigerant flowing through the evaporator, $m = m_1 + m_2 + m_3$
Total mass flowing through the evaporator $= m_1 + m_2 + m_3 = 13 + 15 + 19 = 47$ kg/min
The enthalpy change across the evaporator is h_1 and h_4 .
Total Refrigeration effect = Total mass of refrigerant flowing through the evaporator x enthalpy change across the evaporator
$= m_1 + m_2 + m_3$ (h_1 â€“ h_4)
Refrigeration effect = 47 (170 â€“ 107) = 47 x 63 = 2961 kJ/min.

16. What is the power required to run the following arrangement?





If the values of enthalpy at point 1, 2 and 3 are 193, 258 and 56 kJ/kg and masses are m_1 = 11 kg/min, m_2 = 21 kg/min and m_3 = 28 kg/min.

a) 65 kJ/min
b) 65 kW
c) 3900 kW
d) 4000 kJ/min

Answer: b
Explanation: Given: h_1 = 193 kJ/kg, h_2 = 258 kJ/kg and h_3 = h_4 = 56 kJ/kg
As, the evaporators are connected in such a way that masses get converged and then enter into the compressor.

Total mass of refrigerant flowing through the evaporator, $m = m_1 + m_2 + m_3$
Total mass flowing through the compressor $= m_1 + m_2 + m_3 = 11 + 21 + 28 = 60$ kg/min
The enthalpy change across the compressor is h_1 and h_2.
Work done = Total mass of refrigerant flowing through the compressor x enthalpy change across the compressor.
$= m_1 + m_2 + m_3 (h_2$ â€“ $h_1)$
Work done = 60 (258 â€“ 193) = 60 x 65 = 3900 kJ/min
Power = Work done / 60 = 3900 / 60 = 65 kW.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œClassification of Refrigerantsâ€�.

1. Which of the following is not the type of refrigerant?
a) Organic refrigerants
b) Inorganic refrigerants
c) Azeotrope refrigerants
d) Halo-helium refrigerants

Answer: d
Explanation: Primary refrigerants are classified as Organic, i.e., Halo-Carbon refrigerants, Inorganic refrigerants, Azeotrope refrigerants, and Hydro-carbon refrigerants. Primary refrigerants are the one which takes a direct part in the refrigeration system.

2. When refrigerants take a direct part in the refrigeration system, then these types of refrigerants are called?
a) Primary
b) Secondary
c) Tertiary
d) Mixed

Answer: a
Explanation: Primary refrigerants are the one which takes a direct part in the refrigeration system. By absorbing the latent heat of vaporization effective refrigeration in produced.

3. The refrigerants which are first cooled by _________ refrigerants and then used for cooling purposes are known as ____________ refrigerants.
a) secondary, primary
b) primary, secondary
c) tertiary, primary
d) secondary, tertiary

Answer: b
Explanation Primary refrigerants are the one which takes a direct part in the refrigeration system. By absorbing the latent heat of vaporization effective refrigeration in produced. Whereas, refrigerants used for cooling purpose but firstly cooled by primary refrigerants are secondary refrigerants.

4. What is the number of halo-carbon compound refrigerants present as per ASHRAE?
a) 40
b) 41
c) 42
d) 43

Answer: c
Explanation: As per ASHRAE, i.e., American Society of Heating, Refrigeration and Air-conditioning Engineers, 42 Halo-carbon compounds are identified, but only a few are commonly used.

5. What does azeotrope mean?
a) Type of molecule
b) Type of bond
c) Stable mixture
d) Unstable mixture

Answer: c
Explanation: Azeotrope means a stable mixture of refrigerants; whose phases retain identical compositions over a large range of temperatures.

6. Which one of the following inorganic refrigerants is often used?
a) NH_3

b) CO_2
c) H_2O
d) SO_2

Answer: a
Explanation: Ammonia, i.e., NH_3, is widely used for the refrigeration system. Though it possesses high toxicity due to desirable properties to achieve maximum refrigeration effect is present, it is used frequently.

7. What is the refrigerant number of water?
a) R â€“ 717
b) R â€“ 744
c) R â€“ 118
d) R â€“ 100

Answer: c
Explanation: Water is having refrigerant number as R-118. Whereas, R-717, 744, 100 corresponds to Ammonia, Carbon dioxide, and ethyl chloride.

8. What is the number of halo-carbon compound refrigerants commonly used as per ASHRAE?
a) 42
b) 14
c) 41
d) 15

Answer: b
Explanation: As per ASHRAE, i.e., American Society of Heating, Refrigeration, and Air-conditioning Engineers, 42 Halo-carbon compounds are identified, but only a few are commonly used. The number of commonly used refrigerants is 14. Ex. R-11, 12, 13, 14, 21, 22, 30, 40, 100, 113, 114, 115, 123, 124, 134a, 152a.

9. Which of the following refrigerants are in the Freon group?
a) Organic refrigerants
b) Inorganic refrigerants
c) Azeotrope refrigerants
d) Hydrocarbon refrigerants

Answer: a
Explanation: Freon group is in the Organic or halo-carbon type of refrigerants. Halo-carbon compounds are produced and developed by freon family of refrigerants. Freon is the trademark of E.I. Du Pont de Nemours and Co., America.

10. Hydro-carbon refrigerants are commonly used nowadays.
a) True
b) False

Answer: b
Explanation: Hydro-carbons possess desired properties for refrigeration, but due to high flammability and explosive nature, hydrocarbons are replaced by another less explosive type of refrigerant.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œRefrigerants â€“ Thermodynamic Propertiesâ€�.

1. Among the following refrigerants, which is having the lowest freezing point?
a) R â€“ 21
b) R â€“ 11
c) R â€“ 12
d) R â€“ 22

Answer: d
Explanation: Freezing temperature is a crucial property to carry out refrigeration. Among the given refrigerants, R â€“ 22 is having the lowest freezing point, valued at -160Â°C. R â€“ 11, R â€“ 12 and R â€“ 21 having freezing points as -111Â°C, -157.5Â°C and -135Â°C respectively.

2. What is the boiling point of Ammonia at atmospheric pressure?
a) -10.5Â°C
b) -30Â°C
c) -33.3Â°C
d) -77.7Â°C

Answer: c
Explanation: Ammonia has a boiling point at -33.3Â°C. This low boiling point makes Ammonia possible to get refrigeration below 0Â°C even at atmospheric pressure.

3. R â€“ 717 is the refrigerant number of which of the following refrigerant?
a) Ammonia
b) Water
c) Carbon dioxide
d) Sulphur dioxide

Answer: a
Explanation R â€“ 717 is the refrigerant number of Ammonia. Whereas, refrigerant number of Water, Carbon dioxide, and Sulphur dioxide is R â€“ 118, R â€“ 744 and R â€“ 764 respectively.

4. What is the boiling point of Carbon dioxide at atmospheric pressure?
a) -20.5Â°C
b) -73.6Â°C
c) -50Â°C
d) -68Â°C

Answer: b
Explanation: Carbon dioxide has a boiling point at -73.6Â°C at given conditions. Carbon dioxide is having the lowest boiling point among all the refrigerants which are commonly used due to high capacity o refrigeration.

5. What is the freezing point of R â€“ 12 at atmospheric pressure?
a) -86.6Â°C
b) -73.6Â°C
c) -157.5Â°C
d) -160Â°C

Answer: c
Explanation: R â€“ 12 is having a boiling point at -157.5Â°C at given conditions. R â€“ 12 is having the second-lowest freezing point after R â€“ 22, which is valued at -160Â°C.

6. What is the refrigerant number of Water?
a) R â€“ 717
b) R â€“ 744
c) R â€“ 118
d) R â€“ 100

Answer: c
Explanation: Water is having refrigerant number as R â€“ 118. Whereas, R â€“ 717, 744, 100 corresponds to Ammonia, Carbon dioxide, and ethyl chloride.

7. Among the following refrigerants, which is having the lowest boiling point?
a) Ammonia
b) R â€“ 12
c) Carbon dioxide
d) Sulphur dioxide

Answer: c
Explanation: Boiling point temperature is a crucial property to carry out refrigeration. Among the given refrigerants, Carbon dioxide is having the lowest boiling point, valued at â€“73.6Â°C. Ammonia, R -12 and Sulphur dioxide are having boiling points as -33.3Â°C, -29Â°C and -10Â°C respectively.

8. Among the following refrigerants, which is having the lowest C.O.P for refrigeration system working under the temperature limits of -15Â°C and 30Â°C as evaporator and condenser temperature respectively?
a) Ammonia
b) R â€“ 12
c) R â€“ 30
d) Carbon dioxide

Answer: c
Explanation: Coefficient of performance is the ratio of refrigeration produced and work done to get that refrigeration effect. C.O.P. is a crucial entity. The more the C.O.P., more the refrigeration effect is produced, and lower temperatures can be achieved. Among the given options, Carbon dioxide is having least C.O.P. for given temperatures conditions, which is valued at 2.56. Whereas, Ammonia, R â€“ 12 and R â€“ 30 is having C.O.P. as 4.76, 4.70 and 4.90 respectively.

9. R â€“ 11 is having the highest C.O.P for refrigeration system working under the temperature limits of -15Â°C and 30Â°C as evaporator and condenser temperature respectively.
a) False
b) True

Answer: b
Explanation: Coefficient of performance is the ratio of refrigeration produced and work done to get that refrigeration effect. C.O.P. is a crucial entity. The more the C.O.P., more the refrigeration effect is produced, and lower temperatures can be achieved. For a Carnot cycle, C.O.P. under given conditions is 5.74 and R â€“ 11 posses 5.09 C.O.P. very close to the ideal cycle.

10. A refrigerant should have a low latent heat of vaporization at the evaporator temperature.
a) True
b) False

Answer: b
Explanation: A refrigerant should have a high latent heat of vaporization at the evaporator temperature. More the latent heat of vaporization more is the capacity of refrigerant to absorb heat in the evaporator. So, Higher the value of latent heat of vaporization, higher is the refrigeration effect produced.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œRefrigerants â€“ Chemical Propertiesâ€�.

1. What is right about the flammability of halo-carbon refrigerants?
a) They possess low flammable properties
b) They possess incredibly high flammable properties
c) They are not flammable
d) They possess little flammable properties

Answer: c
Explanation: Halo-carbon contains Hydrogen, Carbon, Chlorine, and Fluorine. Though hydrogen itself is highly flammable and when combined with carbon also given flammable compounds. But when Hydrogen, Carbon, Chlorine, and Fluorine are combined, gives very stable compounds.

2. What is right about the explosive properties of halo-carbon refrigerants?
a) They are not flammable
b) They possess incredibly high explosive properties
c) They possess low explosive properties
d) They possess low explosive properties

Answer: a
Explanation: Halo-carbon contains Hydrogen, Carbon, Chlorine, and Fluorine. Though hydrogen itself is highly explosive and when combined with carbon also given explosive compounds. But when Hydrogen, Carbon, Chlorine, and Fluorine are combined, gives very stable compounds, which are not explosives.

3. In what proportion when Ammonia mixed with air becomes explosive?
a) 10 â€“ 15 % gas by volume
b) 16 â€“ 25 % gas by volume
c) 10 â€“ 15 % gas by weight
d) 16 â€“ 25 % gas by weight

Answer: a
Explanation: Ammonia is somewhat flammable but becomes explosive when mixed with air in the ratio 16 to 25 % gas by volume. Explosive property of ammonia is also widely used in applications.

4. By what ratio, R â€“ 22 has more solubility in water than R â€“ 12?
a) 2:1
b) 4:1
c) 1:2
d) 3:1

Answer: d
Explanation: The solubility of water with R â€“ 22 is more than R â€“ 12 by the ratio 3:1. If more water is present than solubility, ice forms and operation hindrance occurs.

5. A wetted cloth is put at the point of the leak in ammonia refrigeration plants.
a) False
b) True

Answer: b
Explanation: To avoid harms to the person working in ammonia refrigeration plants, a wetted cloth is put at the point of leak due to the property of ammonia being highly soluble in water.

6. What is the ability of refrigerant to mix with oil called?
a) Toxicity
b) Flammability
c) Miscibility
d) Solubility of water

Answer: c
Explanation: Ability of refrigerant to mix with oil is called as miscibility. Miscibility is a secondary factor in the selection of refrigerant. The solubility of water is the ability to mix with water. Whereas, flammability and toxicity have no relevance with the mixing of refrigerants.

7. Among the following refrigerants, which is having relatively higher miscibility?
a) Ammonia
b) R â€“ 12
c) Carbon dioxide
d) Sulphur dioxide

Answer: b
Explanation: R â€“ 12 is relatively more miscible than other refrigerants. It is miscible under all operating conditions due to a more stable structure of the compound. Not only R â€“ 12 but also all refrigerants of Freon group possess higher miscible properties than NH_3, CO_2, and SO_2.

8. What is right about Ammonia?
a) Ammonia is insoluble in water
b) Ammonia spoils the taste of fruits and vegetables when mixed with water
c) Ammonia does not affect the taste of fruits and vegetables when mixed with water
d) Ammonia is not toxic

Answer: b
Explanation: Ammonia is highly soluble in water. After dissolving easy in water, it becomes alkaline or basic. As most of the fruits and vegetables are acidic. Ammonia reacts with these products, and salt formation occurs, and the taste of these products is spoiled totally.

9. Among the following refrigerants, which is the odd refrigerant as per the criterion of toxicity?
a) R â€“ 11
b) R â€“ 12
c) R â€“ 22
d) R â€“ 30

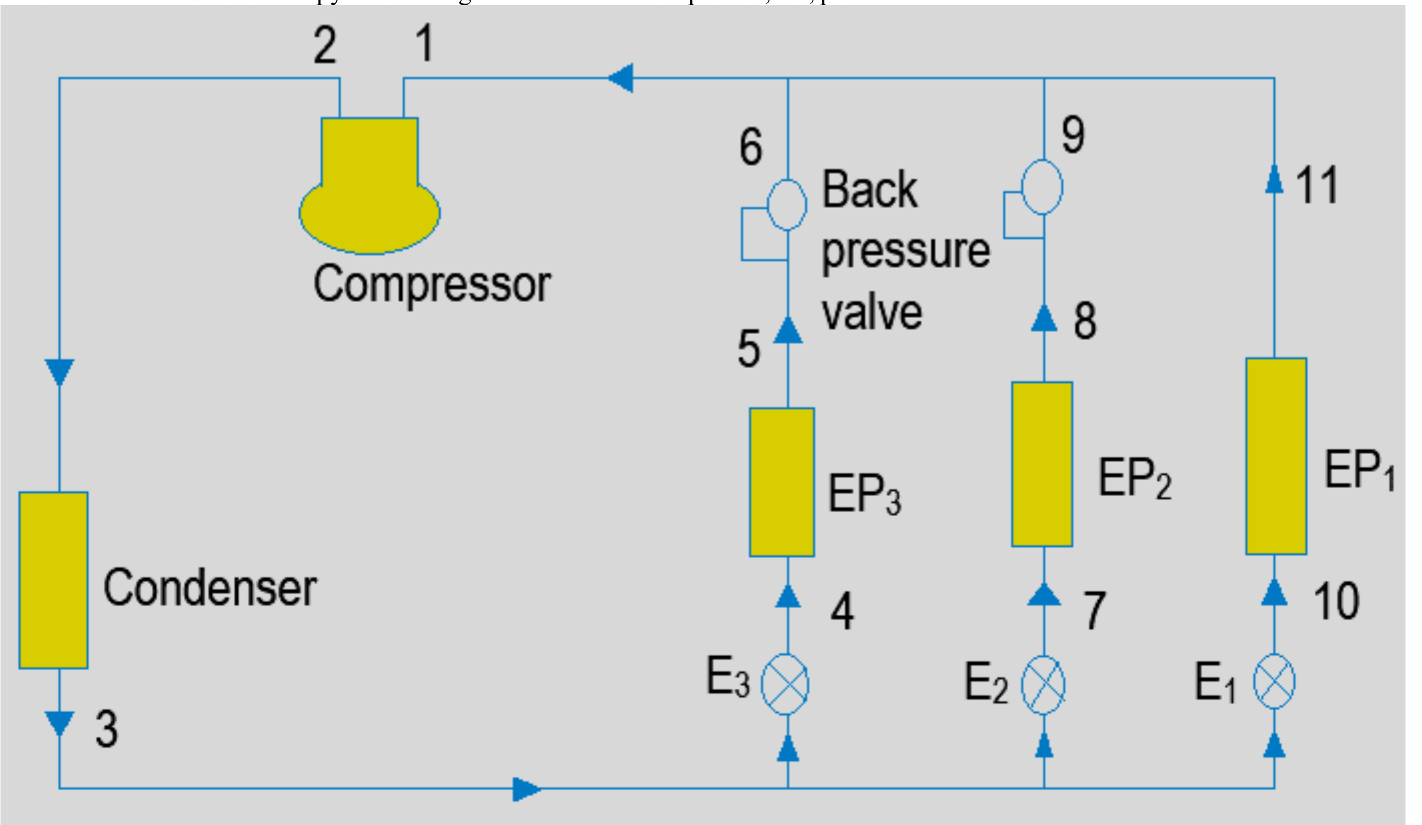
Answer: d
Explanation: R â€“ 30 is the odd man out among the given refrigerants. It produces a serious effect when given time of just 30 minutes of exposure. Toxicity is very high as compared to given refrigerants.
R â€“ 11, R â€“ 12, and R â€“ 22 need 120 minutes of exposure to produce the serious effect of toxicity.

10. R â€“ 764, i.e., Sulphur dioxide is the least toxic refrigerant.
a) False
b) True

Answer: a
Explanation: Sulphur dioxide is the most toxic refrigerant among all refrigerants. It needs just 5 minutes of exposure to produce a serious effect and which are hazardous. Only 0.7% by volume in the air is the requirement to produce this toxicity effect.

This set of Refrigeration written test Questions & Answers focuses on â€œMultiple Evaporators and Compressor System â€“ 2â€�.

1. What is the value of enthalpy when refrigerant enters the compressor, i.e., point 1?

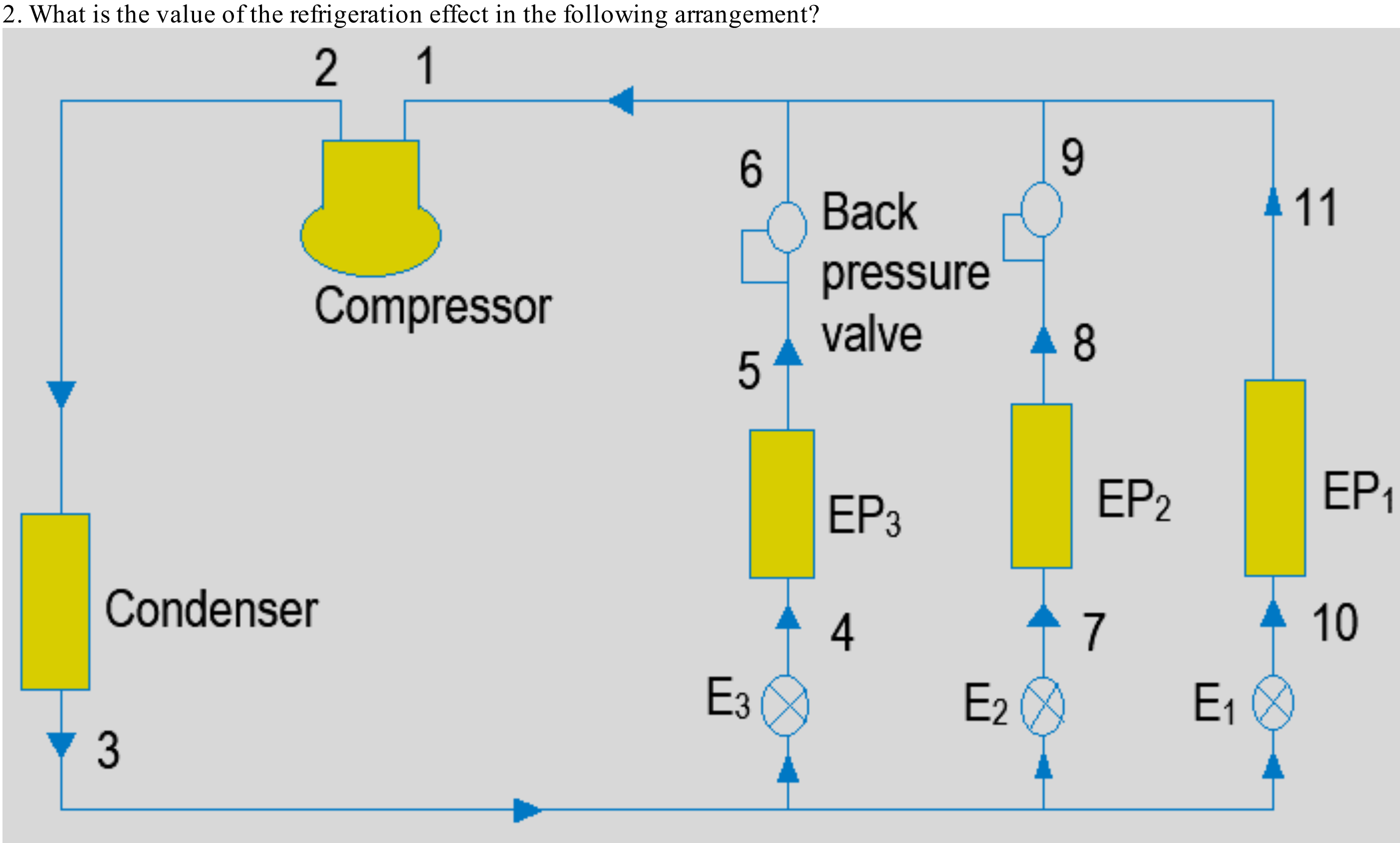


a) $m_1 h_{11} + m_2 h_8 + m_3 h_5 / (m_1 + m_2$ â€“ $m_3)$
b) $m_1 h_{11} + m_2 h_8 + m_3 h_5 / (m_1$ â€“ $m_2 + m_3)$
c) $m_1 h_{11} + m_2 h_8 + m_3 h_5 / (m_1 + m_2 + m_3)$
d) $m_1 h_5 + m_2 h_5 + m_3 h_4 / (m_1 + m_2 + m_3)$

Answer: c
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, $m_1 = 210\ Q_1 / h_{11}$ â€“ h_{10}

$m_2 = 210\ Q_2 / h_8$ â€“ h_7
$m_3 = 210\ Q_3 / h_5$ â€“ h_4
At point 1, mass of refrigerant coming from each evaporator is converging.
So, $(m_1 + m_2 + m_3) h_1 = m_1 h_{11} + m_2 h_8 + m_3 h_5$
$h_1 = m_1 h_{11} + m_2 h_8 + m_3 h_5 / (m_1 + m_2 + m_3)$.

2. What is the value of the refrigeration effect in the following arrangement?

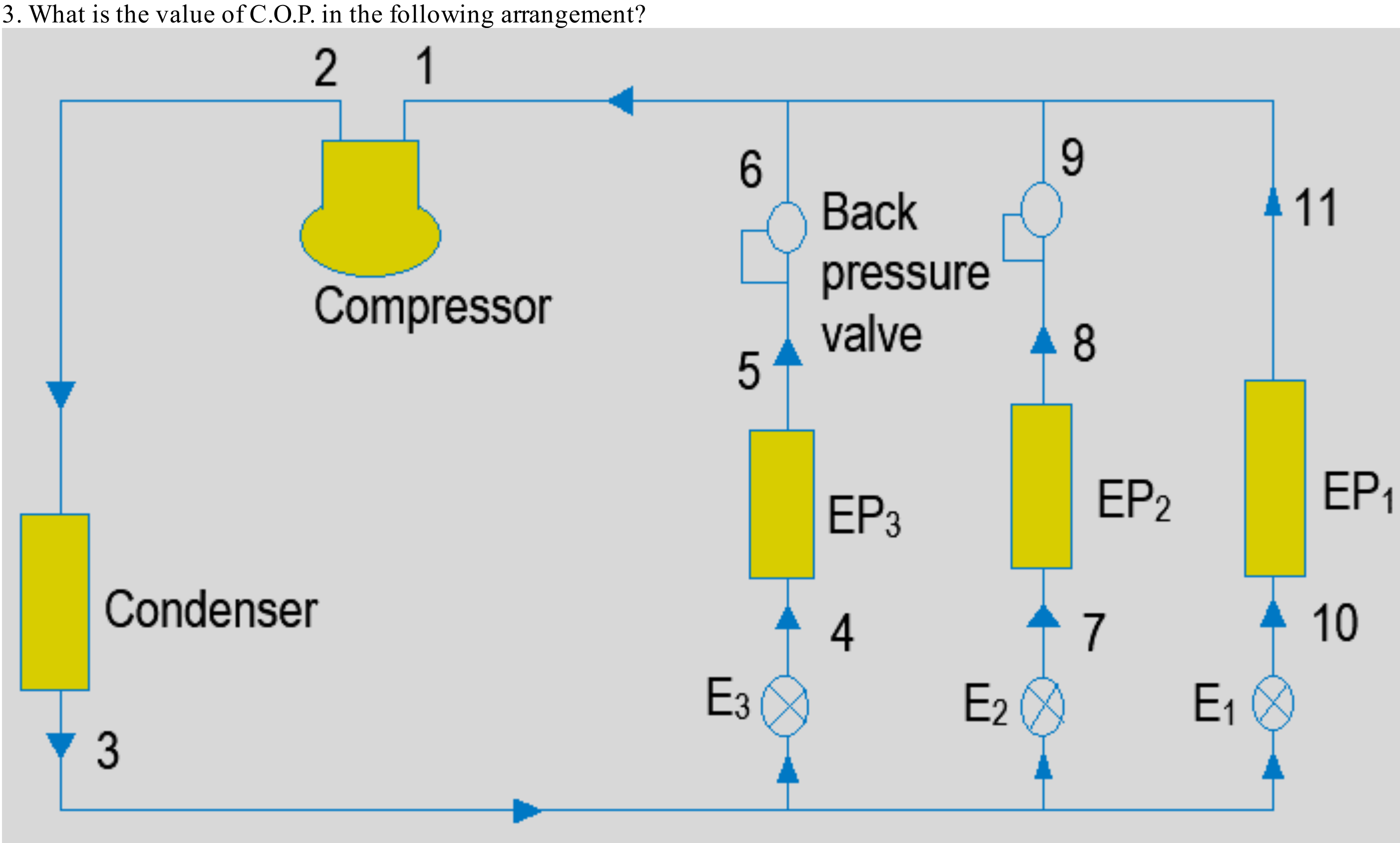


a) $m_1 (h_{11}$ â€“ $h_{10}) + m_2 (h_8$ â€“ $h_1) + m_3 (h_5$ â€“ $h_2)$
b) $m_1 (h_{11}$ â€“ $h_{10}) + m_2 (h_8$ â€“ $h_7) + m_3 (h_5$ â€“ $h_4)$
c) $m_1 (h_{11}$ â€“ $h_{10}) + m_2 (h_8$ â€“ $h_2) + m_3 (h_2$ â€“ $h_4)$

d) $m_1 (h_{11}$ â€“ $h_{10}) + m_2 (h_8$ â€“ $h_7) + m_3 (h_1$ â€“ $h_4)$

Answer: b
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, $m_1 = 210\ Q_1 / h_{11}$ â€“ h_{10}
$m_2 = 210\ Q_2 / h_8$ â€“ h_7
$m_3 = 210\ Q_3 / h_5$ â€“ h_4
So, Refrigeration effect across $EP_1 = m_1 (h_{11}$ â€“ $h_{10})$
Refrigeration effect across $EP_2 = m_2 (h_8$ â€“ $h_7)$
Refrigeration effect across $EP_3 = m_3 (h_5$ â€“ $h_4)$
Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.
Total refrigeration effect $= m_1 (h_{11}$ â€“ $h_{10}) + m_2 (h_8$ â€“ $h_7) + m_3 (h_5$ â€“ $h_4) = 210 (Q_1 + Q_2 + Q_3)$.

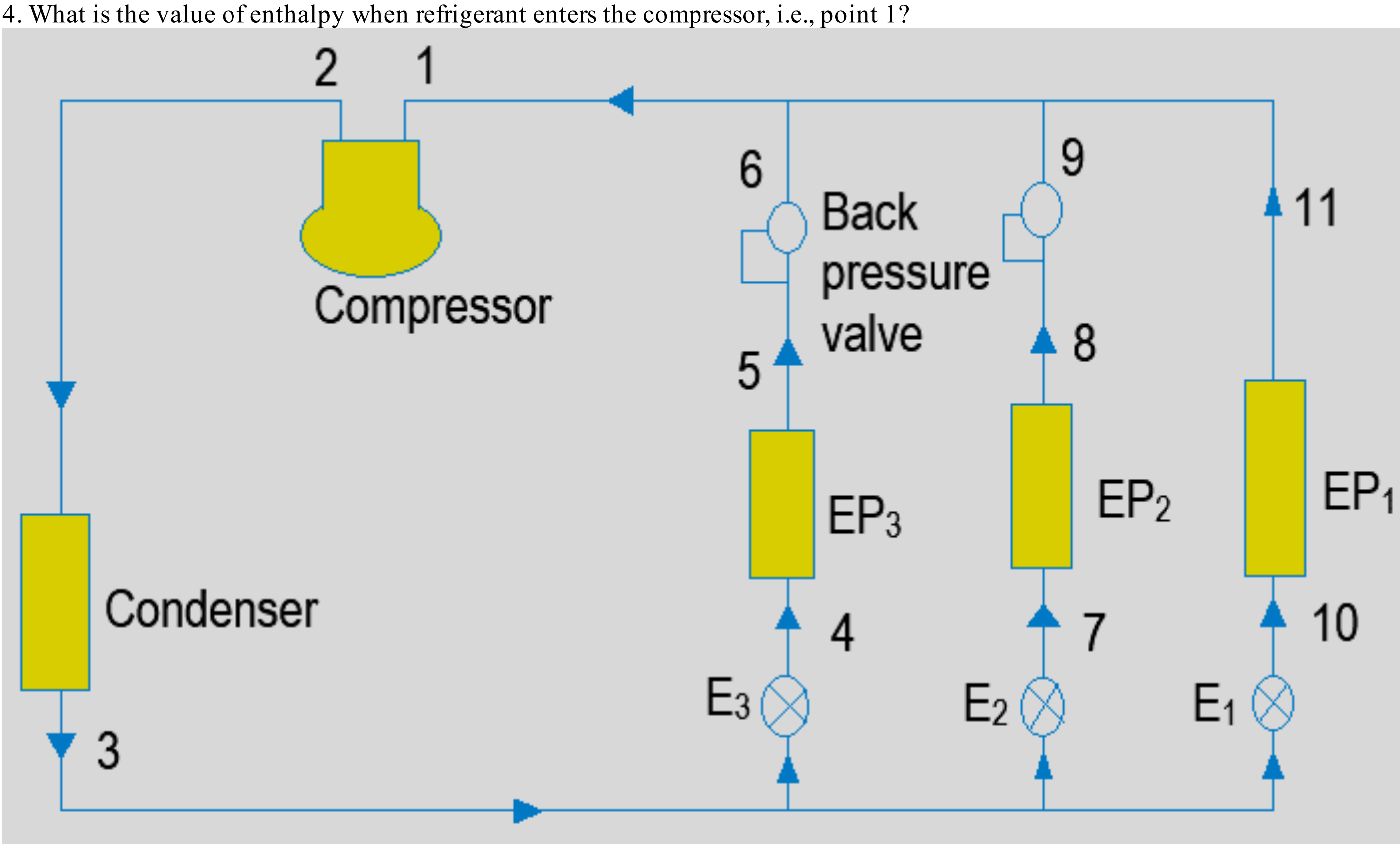
3. What is the value of C.O.P. in the following arrangement?



a) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4) / (m_1 + m_2 + m_3) (h_2 â€“ h_3)
b) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4) / (m_1 + m_2 + m_3) (h_2 â€“ h_7)
c) m_1 (h_{11} â€“ h_{10}) + m_3 (h_8 â€“ h_7) + m_2 (h_5 â€“ h_4) / (m_1 + m_2 + m_3) (h_2 â€“ h_1)
d) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4) / (m_1 + m_2 + m_3) (h_2 â€“ h_1)

Answer: d
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, m_1 = 210 Q_1 / h_{11} â€“ h_{10}
m_2 = 210 Q_2 / h_8 â€“ h_7
m_3 = 210 Q_3 / h_5 â€“ h_4
So, Refrigeration effect across EP_1 = m_1 (h_{11} â€“ h_{10})
Refrigeration effect across EP_2 = m_2 (h_8 â€“ h_7)
Refrigeration effect across EP_3 = m_3 (h_5 â€“ h_4)
Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.
Total refrigeration effect = m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4) = 210 (Q_1 + Q_2 + Q_3)
Work = (m_1 + m_2 + m_3) (h_2 â€“ h_1)
C.O.P. = Total refrigeration effect / Work
= m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4) / (m_1 + m_2 + m_3) (h_2 â€“ h_1)
= 210 (Q_1 + Q_2 + Q_3) / (m_1 + m_2 + m_3) (h_2 â€“ h_1).

4. What is the value of enthalpy when refrigerant enters the compressor, i.e., point 1?

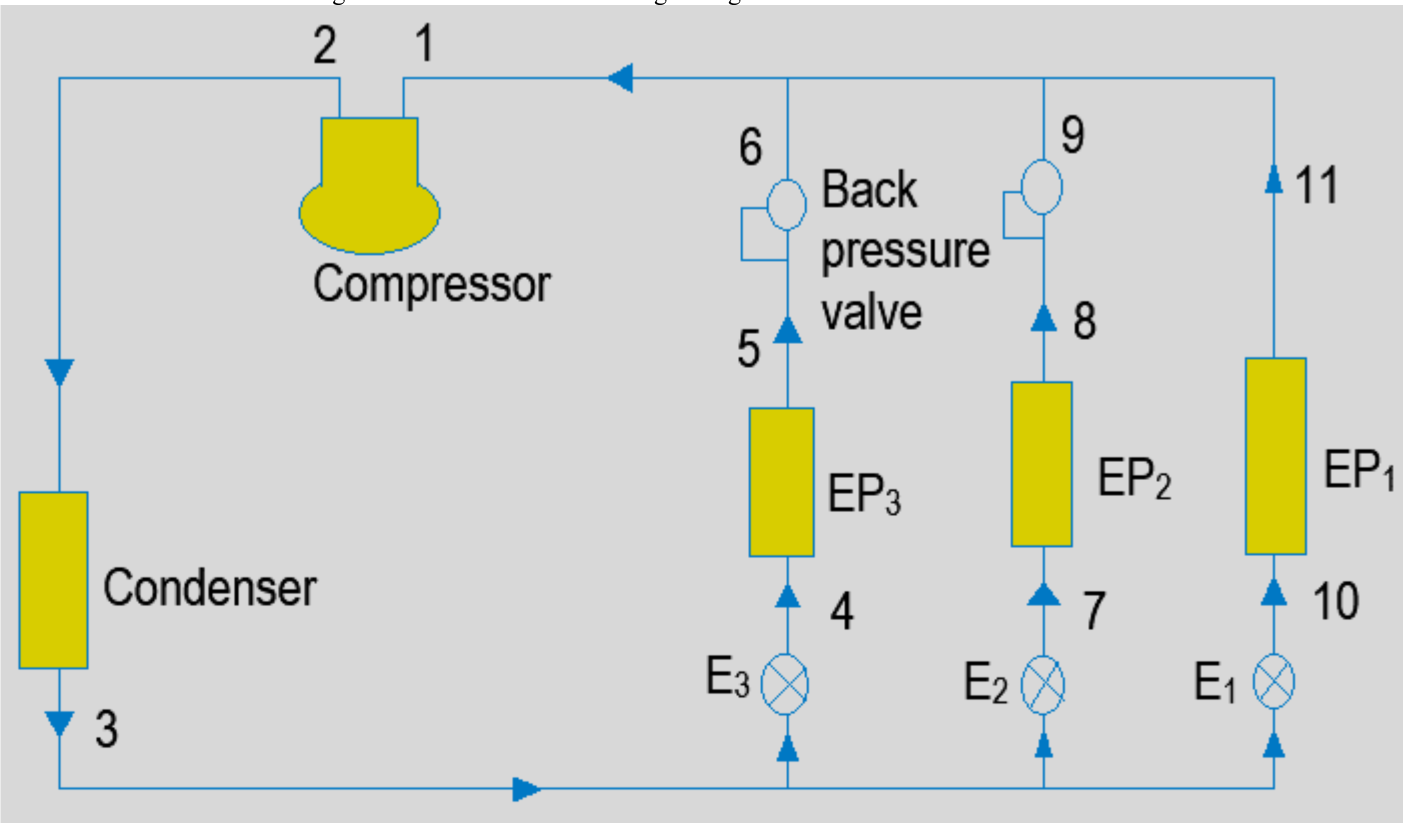


a) $m_{e1} h_{11} + m_{e2} h_9 + m_{e3} h_6 / (m_{e1} + m_{e2} + m_{e3})$
b) $m_{e1} h_{11} + m_{e2} h_9 + m_{e3} h_5 / (m_{e1} + m_{e2} + m_{e3})$
c) $m_{e1} h_{11} + m_{e2} h_8 + m_{e3} h_6 / (m_{e1} + m_{e2} + m_{e3})$
d) $m_1 h_5 + m_2 h_5 + m_3 h_4 / (m_1 + m_2 + m_3)$

Answer: a
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, $m_1 = m_{e1} = 210\ Q_1 / h_{11}$ â€“ h_{10}

$m_2 = 210\, Q_2 / h_9$ â€“ h_7, $m_{e2} = m_2 + m_{e1}$ (x_7 / 1 â€“ x_7)
$m_3 = 210\, Q_3 / h_6$ â€“ h_4, $m_{e3} = m_3 + (m_{e1} + m_{e2})$ (x_4 / 1 â€“ x_4)
At point 1, mass of refrigerant coming from each evaporator is converging.
So, $(m_{e1} + m_{e2} + m_{e3})\, h_1 = m_{e1} h_{11} + m_{e2} h_9 + m_{e3} h_6$
$h_1 = m_{e1} h_{11} + m_{e2} h_9 + m_{e3} h_6 / (m_{e1} + m_{e2} + m_{e3})$.

5. What is the value of the refrigeration effect in the following arrangement?

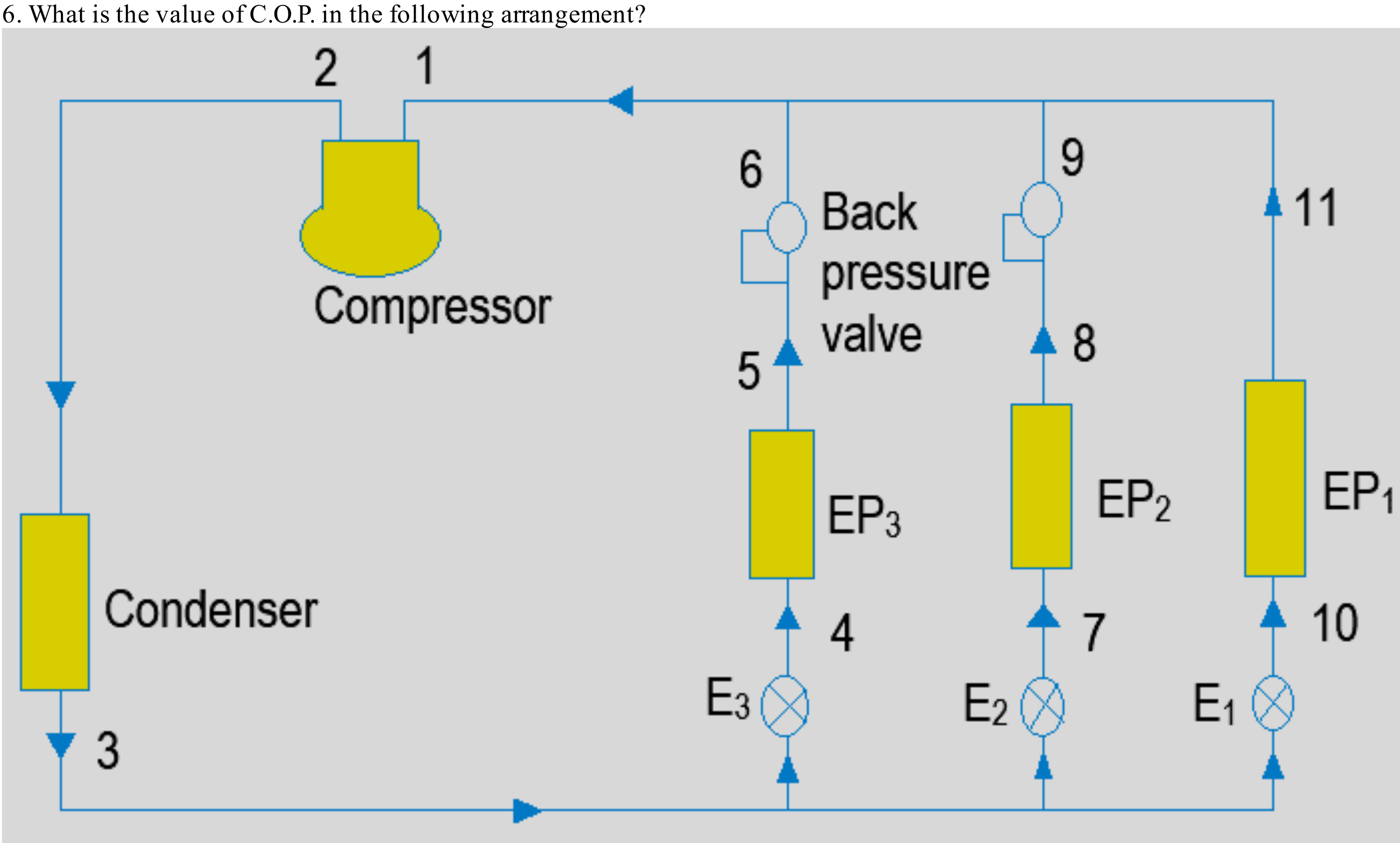


a) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_1) + m_3 (h_5 â€“ h_2)
b) m_1 (h_{11} â€“ h_{10}) + m_2 (h_9 â€“ h_7) + m_3 (h_6 â€“ h_4)
c) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_2) + m_3 (h_2 â€“ h_4)

d) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_1 â€“ h_4)

Answer: b
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, m_1 = 210 Q_1 / h_{11} â€“ h_{10}
m_2 = 210 Q_2 / h_9 â€“ h_7
m_3 = 210 Q_3 / h_6 â€“ h_4
So, Refrigeration effect across EP_1 = m_1 (h_{11} â€“ h_{10})
Refrigeration effect across EP_2 = m_2 (h_9 â€“ h7)
Refrigeration effect across EP_3 = m_3 (h6 â€“ h_4)
Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.
Total refrigeration effect = m_1 (h_{11} â€“ h_{10}) + m_2 (h_9 â€“ h_7) + m_3 (h_6 â€“ h_4) = 210 (Q_1 + Q_2 + Q_3).

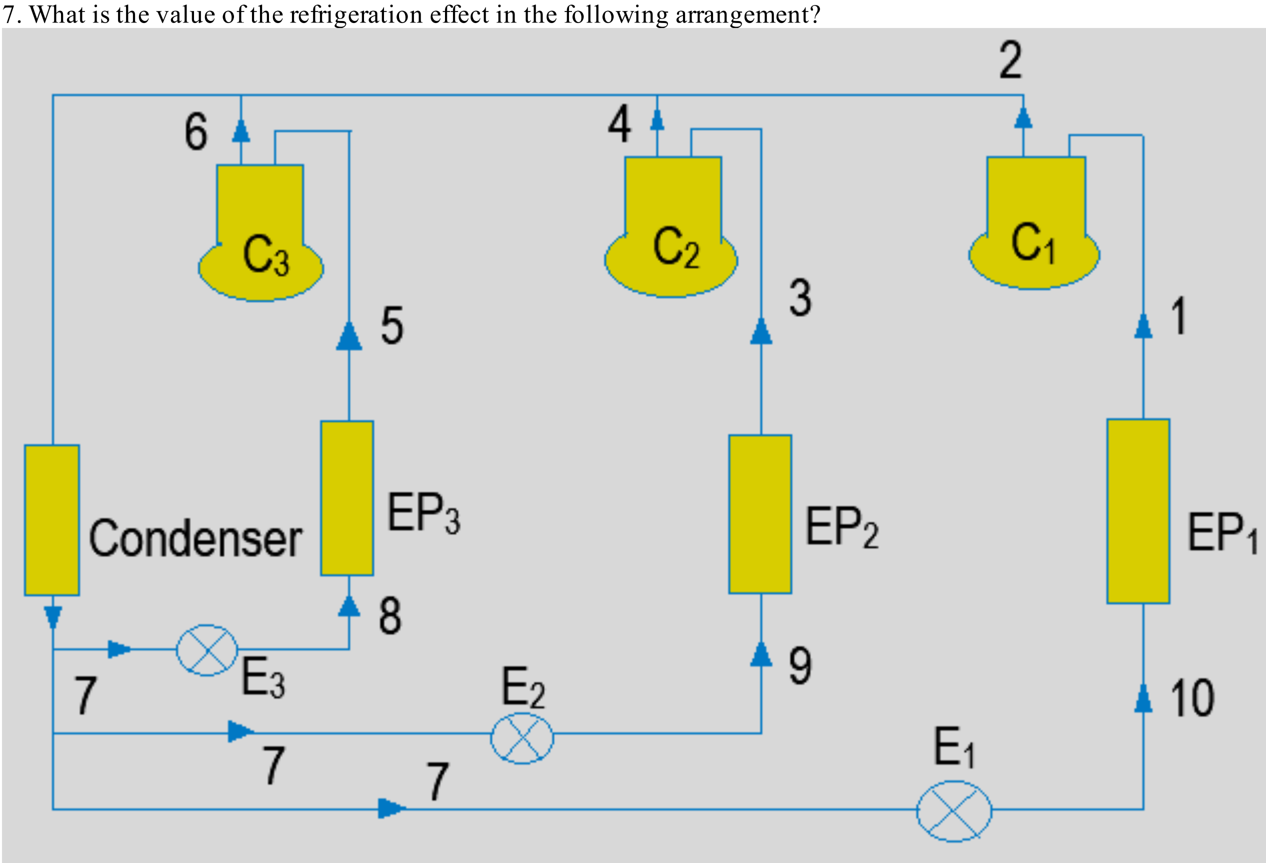
6. What is the value of C.O.P. in the following arrangement?



a) m_1 (h_{11} â€“ h_{10}) + m_2 (h_9 â€“ h_7) + m_3 (h_6 â€“ h_4) / (m_{e1} + m_{e2} + m_{e3}) (h_2 â€“ h_1)
b) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4) / (m_1 + m_2 + m_3) (h_2 â€“ h_7)
c) m_1 (h_{11} â€“ h_{10}) + m_2 (h_9 â€“ h_7) + m_3 (h_6 â€“ h_1) / (m_{e1} + m_{e2} + m_{e3}) (h_2 â€“ h_8)
d) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4) / (m_1 + m_2 + m_3) (h_2 â€“ h_1)

Answer: a
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, m_1 = 210 Q_1 / h_{11} â€“ h_{10}
m_2 = 210 Q_2 / h_9 â€“ h_7
m_3 = 210 Q_3 / h_6 â€“ h_4
So, Refrigeration effect across EP_1 = m_1 (h_{11} â€“ h_{10})
Refrigeration effect across EP_2 = m_2 (h_9 â€“ h_7)
Refrigeration effect across EP_3 = m_3 (h_6 â€“ h_4)
Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.
Total refrigeration effect = m_1 (h_{11} â€“ h_{10}) + m_2 (h_9 â€“ h_7) + m_3 (h_6 â€“ h_4) = 210 (Q_1 + Q_2 + Q_3)
Work = (m_{e1} + m_{e2} + m_{e3}) (h_2 â€“ h_1)
C.O.P. = Total refrigeration effect / Work
= m_1 (h_{11} â€“ h_{10}) + m_2 (h_9 â€“ h_7) + m_3 (h_6 â€“ h_4) / (m_{e1} + m_{e2} + m_{e3}) (h_2 â€“ h_1)
= 210 (Q_1 + Q_2 + Q_3) / (m_{e1} + m_{e2} + m_{e2}) (h_2 â€“ h_1).

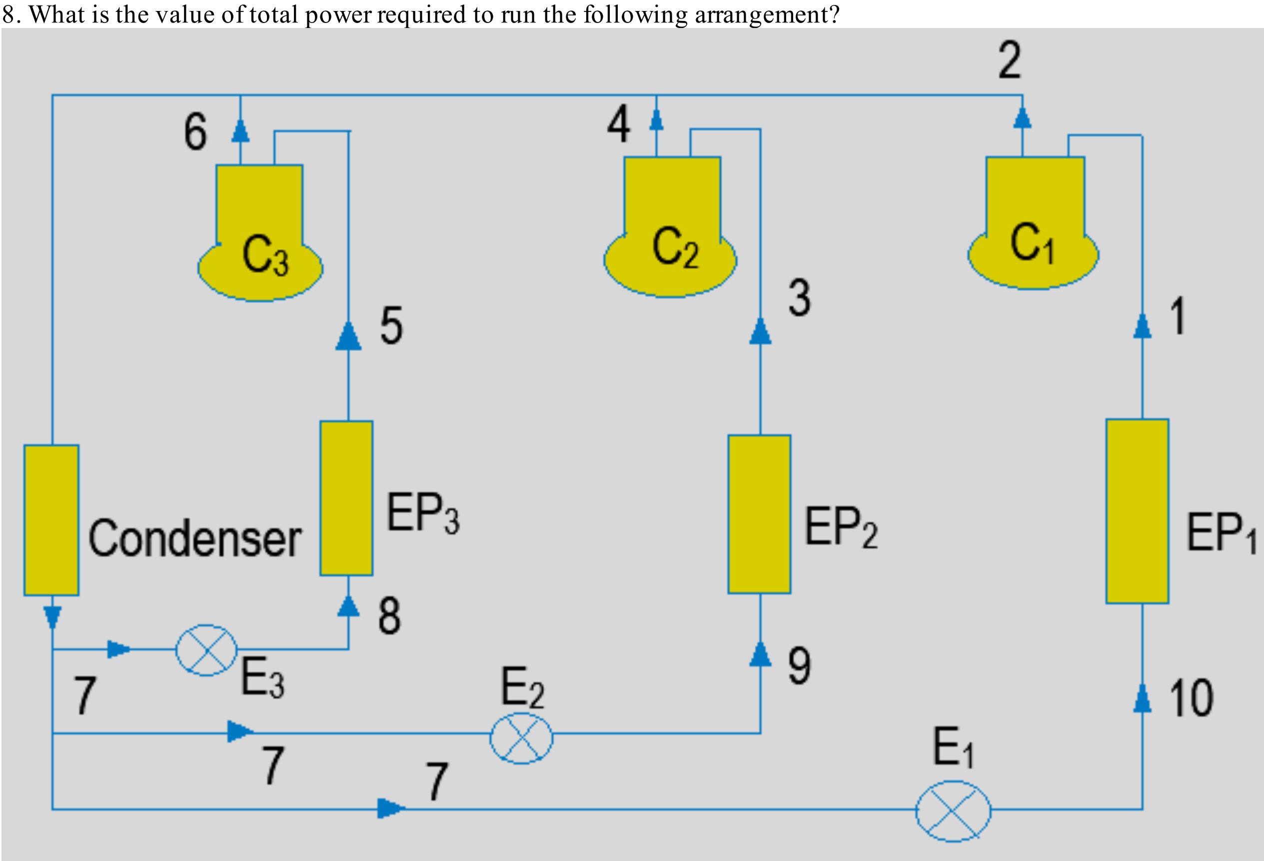
7. What is the value of the refrigeration effect in the following arrangement?



a) m_1 (h_1 â€“ h_{10}) + m_2 (h_8 â€“ h_1) + m_3 (h_5 â€“ h_2)
b) m_1 (h_1 â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_5 â€“ h_4)
c) m_1 (h_1 â€“ h_{10}) + m_2 (h_3 â€“ h_9) + m_3 (h_5 â€“ h_8)
d) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_1 â€“ h_4)

Answer: c
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, $m_1 = 210\ Q_1 / h_1$ â€“ h_{10}
$m_2 = 210\ Q_2 / h_3$ â€“ h_9
$m_3 = 210\ Q_3 / h_5$ â€“ h_8
So, Refrigeration effect across $EP_1 = m_1$ (h_1 â€“ h_{10})
Refrigeration effect across $EP_2 = m_2$ (h_3 â€“ h_9)
Refrigeration effect across $EP_3 = m_3$ (h_5 â€“ h_8)
Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.
Total refrigeration effect = m_1 (h_1 â€“ h_{10}) + m_2 (h_3 â€“ h_9) + m_3 (h_5 â€“ h_8) = 210 ($Q_1 + Q_2 + Q_3$).

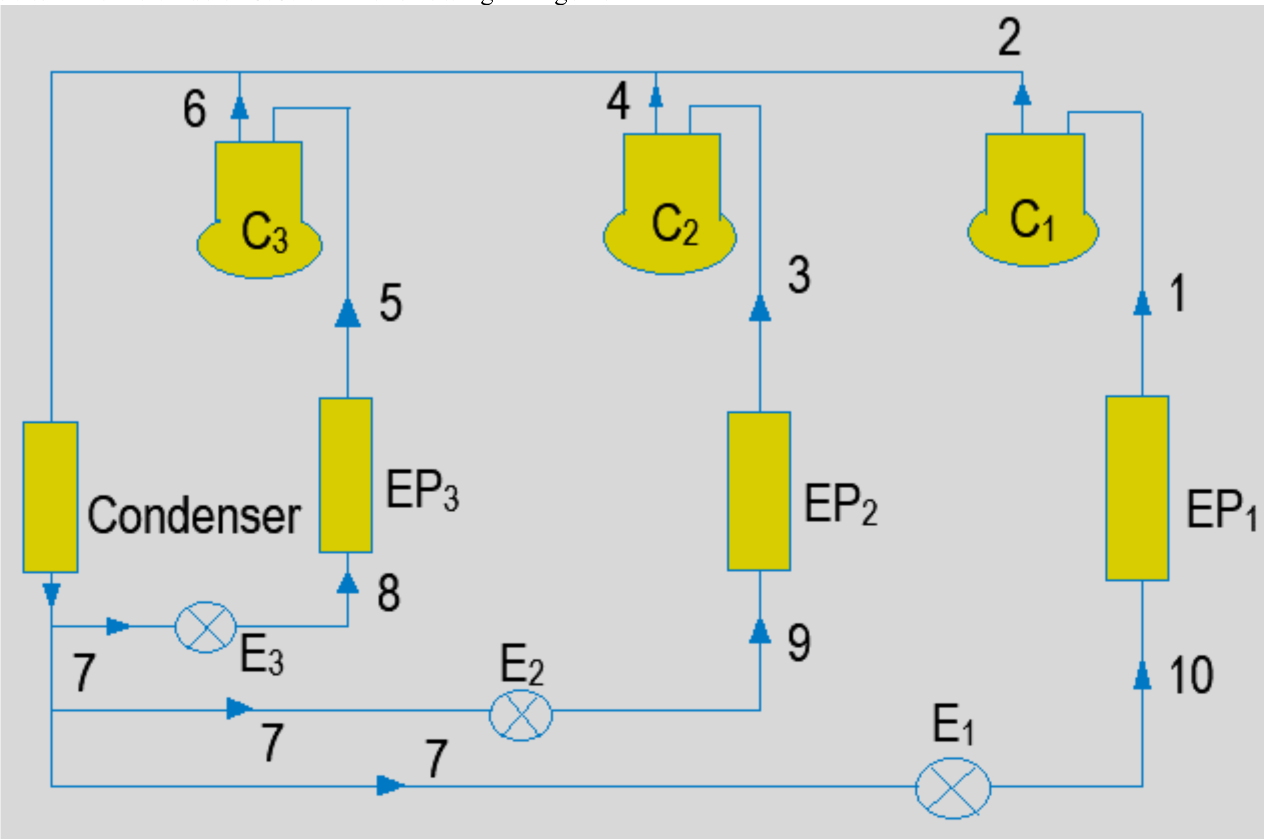
8. What is the value of total power required to run the following arrangement?



a) $m_1 (h_2 \text{ â€“ } h_1) + m_3 (h_4 \text{ â€“ } h_3) + m_2 (h_6 \text{ â€“ } h_1)$
b) $m_1 (h_2 \text{ â€“ } h_1) + m_2 (h_4 \text{ â€“ } h_3) + m_3 (h_6 \text{ â€“ } h_5)$
c) $m_2 (h_2 \text{ â€“ } h_1) + m_3 (h_4 \text{ â€“ } h_3) + m_1 (h_6 \text{ â€“ } h_5) / 60$
d) $m_1 (h_2 \text{ â€“ } h_1) + m_2 (h_4 \text{ â€“ } h_3) + m_3 (h_6 \text{ â€“ } h_5) / 60$

Answer: d
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through compressors C_1, C_2 and C_3
So, Power required to run compressor $C_1 = m_1 (h_2 \text{ â€“ } h_1) / 60$
Power required to run compressor $C_2 = m_2 (h_4 \text{ â€“ } h_3) / 60$
Power required to run compressor $C_3 = m_3 (h_6 \text{ â€“ } h_5) / 60$
Total power required to run the system will be summation of power required to run each compressor.
Total power required to run the system = $m_1 (h_2 \text{ â€“ } h_1) + m_2 (h_4 \text{ â€“ } h_3) + m_3 (h_6 \text{ â€“ } h_5) / 60$.

9. What is the value of C.O.P. in the following arrangement?



a) $m_1 (h_{11}$ â€“ $h_{10}) + m_2 (h_8$ â€“ $h_7) + m_3 (h_5$ â€“ $h_4) / (m_1 + m_2 + m_3) (h_2$ â€“ $h_3)$
b) $m_1 (h_1$ â€“ $h_{10}) + m_2 (h_3$ â€“ $h_9) + m_3 (h_5$ â€“ $h_8) / m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3) + m_3 (h_6$ â€“ $h_5)$
c) $m_1 (h_1$ â€“ $h_{10}) + m_2 (h_3$ â€“ $h_9) + m_3 (h_5$ â€“ $h_8) / m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_2) + m_3 (h_6$ â€“ $h_3)$
d) $m_1 (h_{11}$ â€“ $h_{10}) + m_2 (h_8$ â€“ $h_7) + m_3 (h_5$ â€“ $h_4) / (m_1 + m_2 + m_3) (h_2$ â€“ $h_1)$

Answer: b

Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.

Where, $m_1 = 210\ Q_1 / h_1$ â€“ h_{10}

$m_2 = 210\ Q_2 / h_3$ â€“ h_9

$m_3 = 210\ Q_3 / h_5$ â€“ h_8

So, Refrigeration effect across $EP_1 = m_1 (h_1$ â€“ $h_{10})$

Refrigeration effect across $EP_2 = m_2 (h_3$ â€“ $h_9)$

Refrigeration effect across $EP_3 = m_3 (h_5$ â€“ $h_8)$

Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.

Total refrigeration effect $= m_1 (h_1$ â€“ $h_{10}) + m_2 (h_3$ â€“ $h_9) + m_3 (h_5$ â€“ $h_8) = 210 (Q_1 + Q_2 + Q_3)$

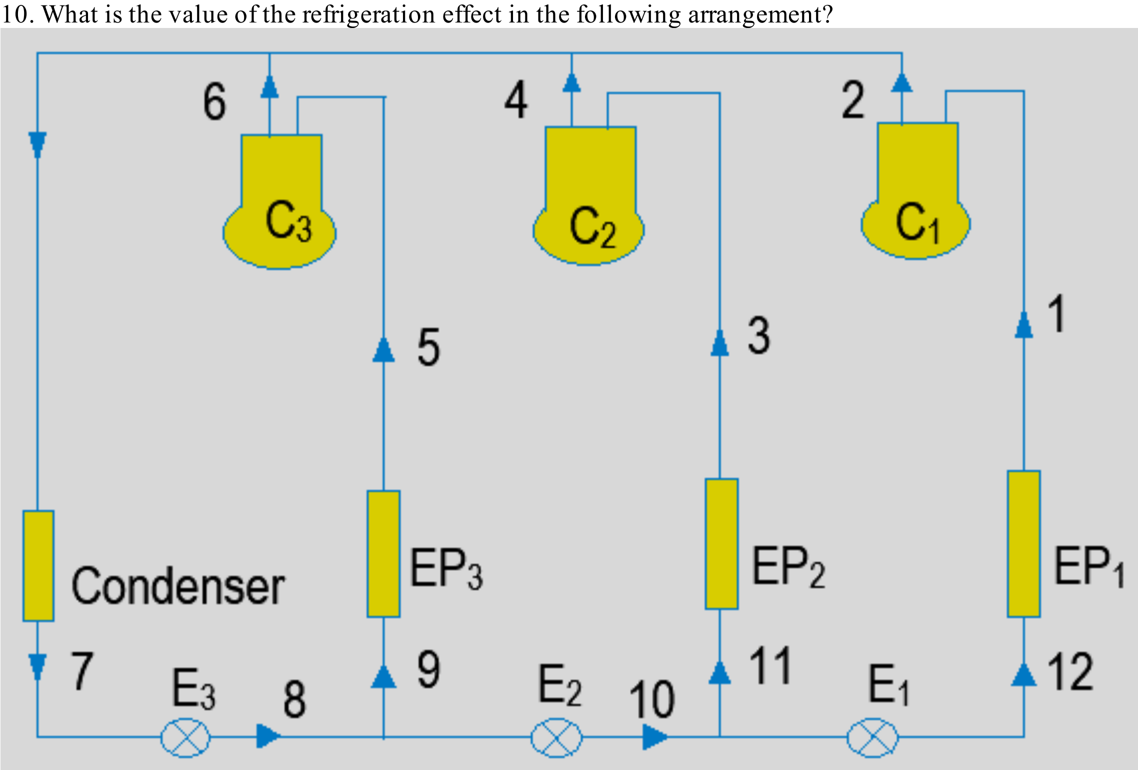
Total Work $= m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3) + m_3 (h_9$ â€“ $h_5)$

C.O.P. = Total refrigeration effect / Work

$= m_1 (h_1$ â€“ $h_{10}) + m_2 (h_3$ â€“ $h_9) + m_3 (h_5$ â€“ $h_8) / m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3) + m_3 (h_6$ â€“ $h_5)$

$= 210 (Q_1 + Q_2 + Q_3) / m_1 (h_2$ â€“ $h_1) + m_2 (h_4$ â€“ $h_3) + m_3 (h_9$ â€“ $h_5)$.

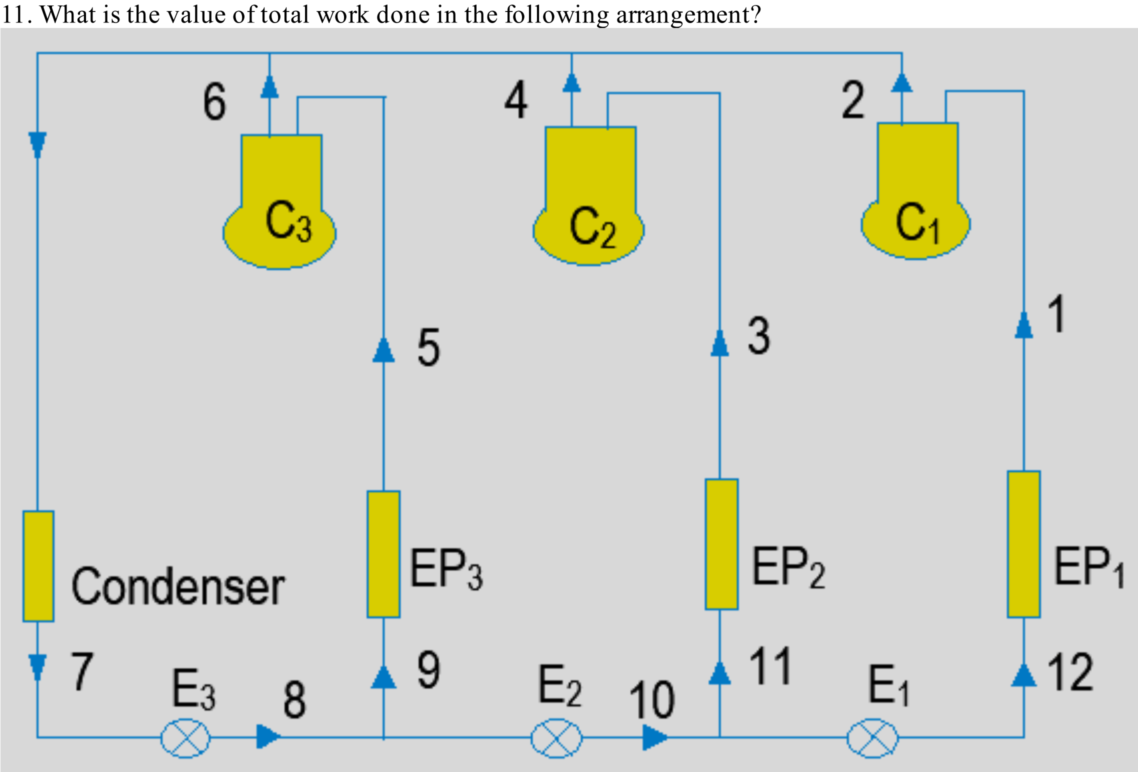
10. What is the value of the refrigeration effect in the following arrangement?



a) m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8)
b) m_1 (h_{11} â€“ h_{10}) + m_2 (h_9 â€“ h_7) + m_3 (h_6 â€“ h_4)
c) m_1 (h_1 â€“ h_{12}) + m_2 (h_9 â€“ h_{10}) + m_3 (h_5 â€“ h_4)
d) m_1 (h_{11} â€“ h_{10}) + m_2 (h_8 â€“ h_7) + m_3 (h_1 â€“ h_4)

Answer: a
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, m_1 = 210 Q_1 / h_1 â€“ h_{12}
m_2 = 210 Q_2 / h_3 â€“ h_{10}
m_3 = 210 Q_3 / h_5 â€“ h_8
So, Refrigeration effect across EP_1 = m_1 (h_1 â€“ h_{12})
Refrigeration effect across EP_2 = m_2 (h_3 â€“ h_{10})
Refrigeration effect across EP_3 = m_3 (h_5 â€“ h_8)
Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.
Total refrigeration effect = m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8) = 210 (Q_1 + Q_2 + Q_3).

11. What is the value of total work done in the following arrangement?

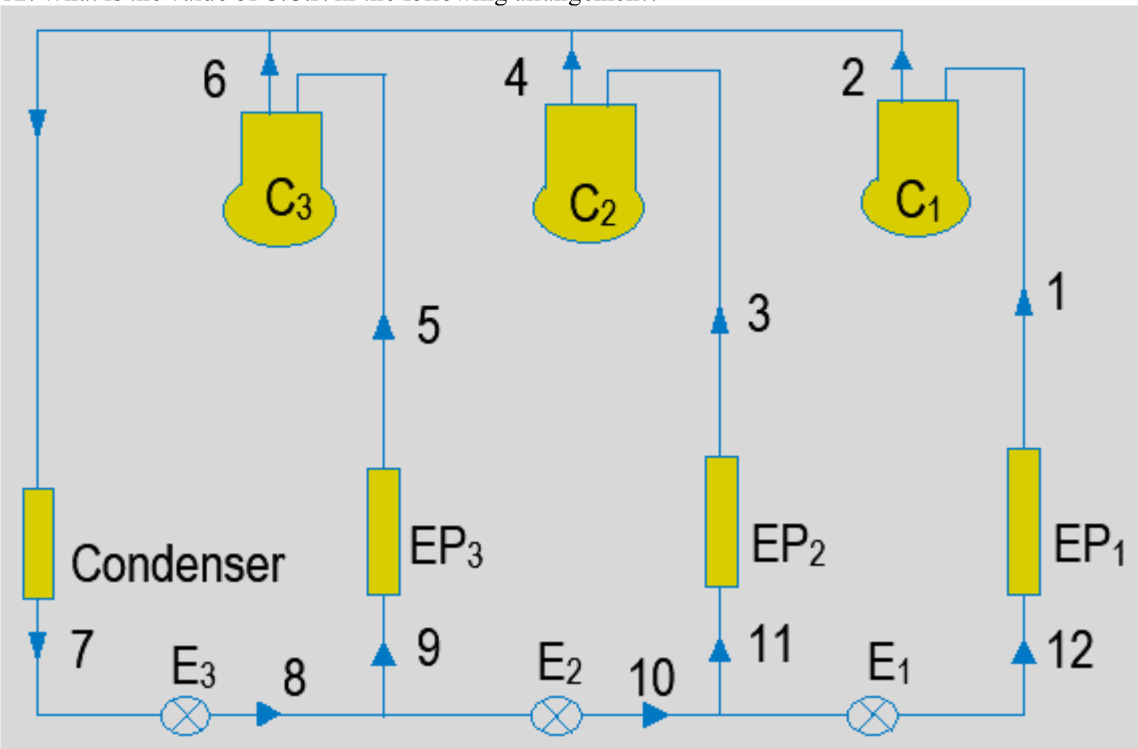


a) m_{e1} (h_2 â€“ h_1) + m_{e2} (h_4 â€“ h_3) + m_{e3} (h_4 â€“ h_5)
b) m_{e1} (h_2 â€“ h_1) + m_{e3} (h_4 â€“ h_3) + m_{e2} (h_6 â€“ h_5)
c) m_{e1} (h_2 â€“ h_1) + m_{e3} (h_4 â€“ h_3) + m_{e3} (h_6 â€“ h_5)
d) $m_1 h_5 + m_2 h_5 + m_3 h_4 / (m_1 + m_2 + m_3)$

Answer: c
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, $m_1 = m_{e1} = 210\ Q_1 / h_1$ â€“ h_{12}

$m_2 = 210\,Q_2 / h_3$ â€“ h_{10}, $m_{e2} = m_2 + m_{e1}$ (x_{10} / 1 â€“ x_{10})
$m_3 = 210\,Q_3 / h_5$ â€“ h_8, $m_{e3} = m_3 + (m_{e1} + m_{e2})$ (x_8 / 1 â€“ x_8)
Total work done is the summation of work done by each compressor.
So, Work done by compressor $C_1 = m_{e1}$ (h_2 â€“ h_1)
Work done by compressor $C_2 = m_{e2}$ (h_4 â€“ h_3)
Work done by compressor $C_3 = m_{e3}$ (h_6 â€“ h_5)
Total work = m_{e1} (h_2 â€“ h_1) + m_{e2} (h_4 â€“ h_3) + m_{e3} (h_6 â€“ h_5).

12. What is the value of C.O.P. in the following arrangement?

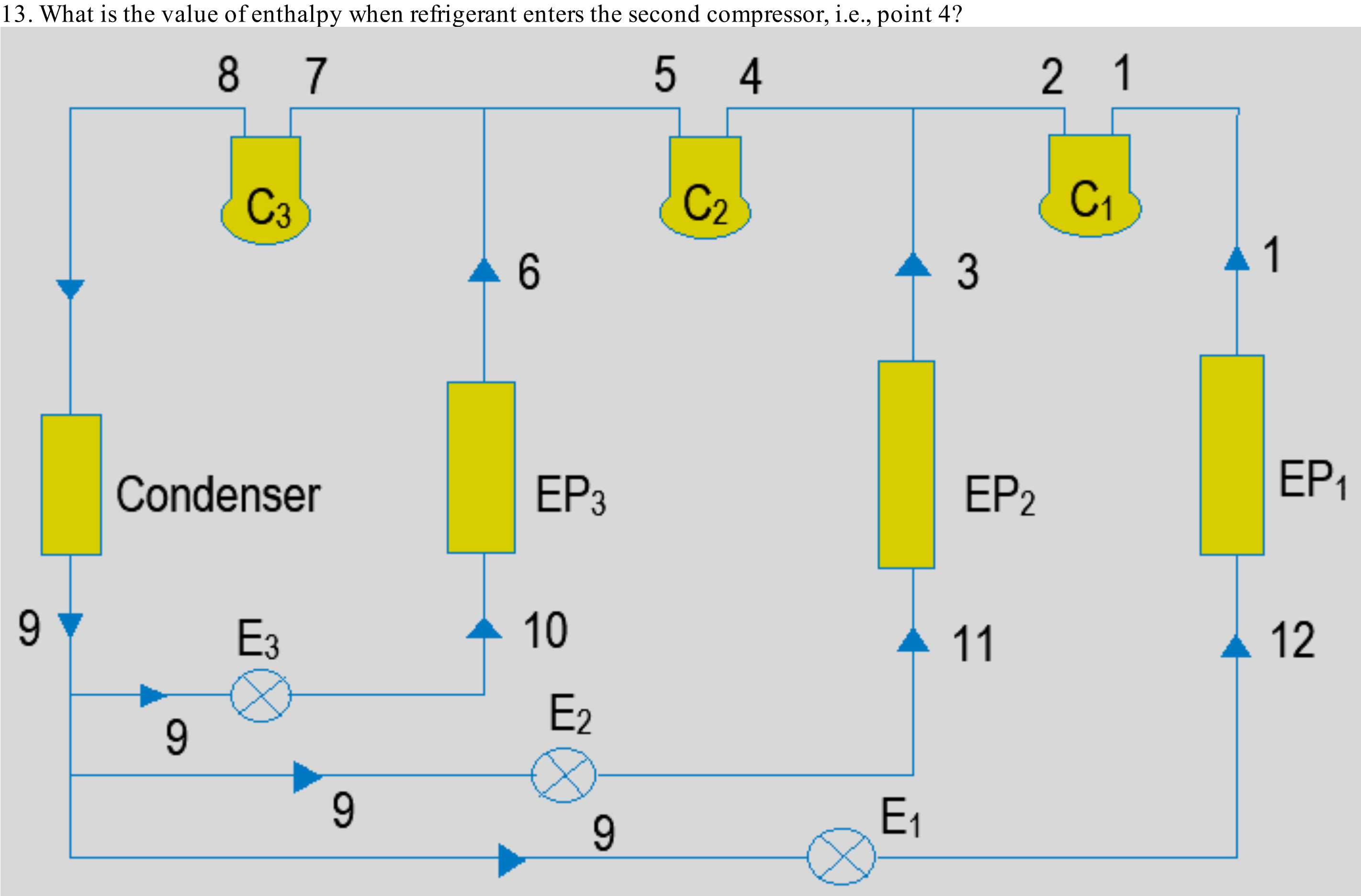


a) m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8)

b) m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8) / m_{e1} (h_2 â€“ h_1) + m_{e2} (h_4 â€“ h_3) + m_{e3} (h_6 â€“ h_5)
c) m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8) / m_{e1} (h_2 â€“ h_5) + m_{e2} (h_4 â€“ h_2) + m_{e3} (h_6 â€“ h_5)
d) m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8) / m_{e1} (h_2 â€“ h_1) + m_{e2} (h_4 â€“ h_1) + m_{e3} (h_6 â€“ h_1)

Answer: b
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, m_1 = 210 Q_1 / h_1 â€“ h_{12}
m_2 = 210 Q_2 / h_3 â€“ h_{10}
m_3 = 210 Q_3 / h_5 â€“ h_8
So, Refrigeration effect across EP_1 = m_1 (h_1 â€“ h_{12})
Refrigeration effect across EP_2 = m_2 (h_3 â€“ h_{10})
Refrigeration effect across EP_3 = m_3 (h_5 â€“ h_8)
Total refrigeration effect produced in the system is the summation of refrigeration effect across each evaporator.
Total refrigeration effect = m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8) = 210 (Q_1 + Q_2 + Q_3)
So, Work done by compressor C_1 = m_{e1} (h_2 â€“ h_1)
Work done by compressor C_2 = m_{e2} (h_4 â€“ h_3)
Work done by compressor C_3 = m_{e3} (h_6 â€“ h_5)
Total work = m_{e1} (h_2 â€“ h_1) + m_{e2} (h_4 â€“ h_3) + m_{e3} (h_6 â€“ h_5)
C.O.P. = Total refrigeration effect / Total work done
= m_1 (h_1 â€“ h_{12}) + m_2 (h_3 â€“ h_{10}) + m_3 (h_5 â€“ h_8) / m_{e1} (h_2 â€“ h_1) + m_{e2} (h_4 â€“ h_3) + m_{e3} (h_6 â€“ h_5).

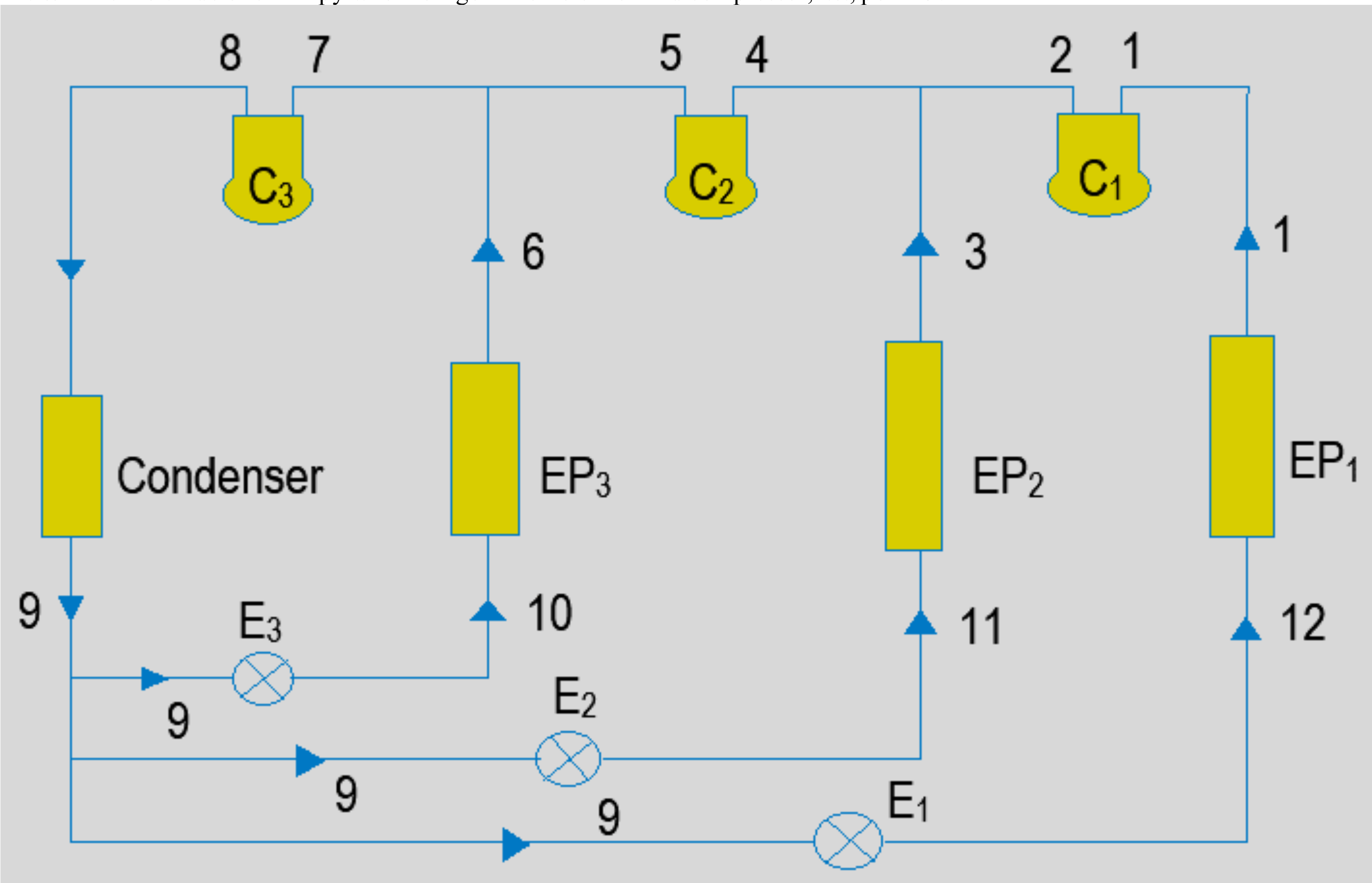
13. What is the value of enthalpy when refrigerant enters the second compressor, i.e., point 4?



a) $m_1 h_2 + m_2 h_3 / (m_1 + m_2)$
b) $m_1 h_{11} + m_2 h_8 + m_3 h_5 / (m_1$ â€“ $m_2 + m_3)$
c) $m_1 h_2 + m_2 h_1 / (m_1 + m_2)$
d) $m_1 h_5 + m_2 h_5 + m_3 h_4 / (m_1 + m_2 + m_3)$

Answer: a
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, $m_1 = 210\ Q_1 / h_1$ â€“ h_{12}
$m_2 = 210\ Q_2 / h_2$ â€“ h_{11}
$m_3 = 210\ Q_3 / h_6$ â€“ h_{10}
At point 4, mass of refrigerant coming from evaporator 1 and 2 is converging.
So, $(m_1 + m_2) h_4 = m_1 h_2 + m_2 h_3$
$h_4 = m_1 h_2 + m_2 h_3 / (m_1 + m_2)$.

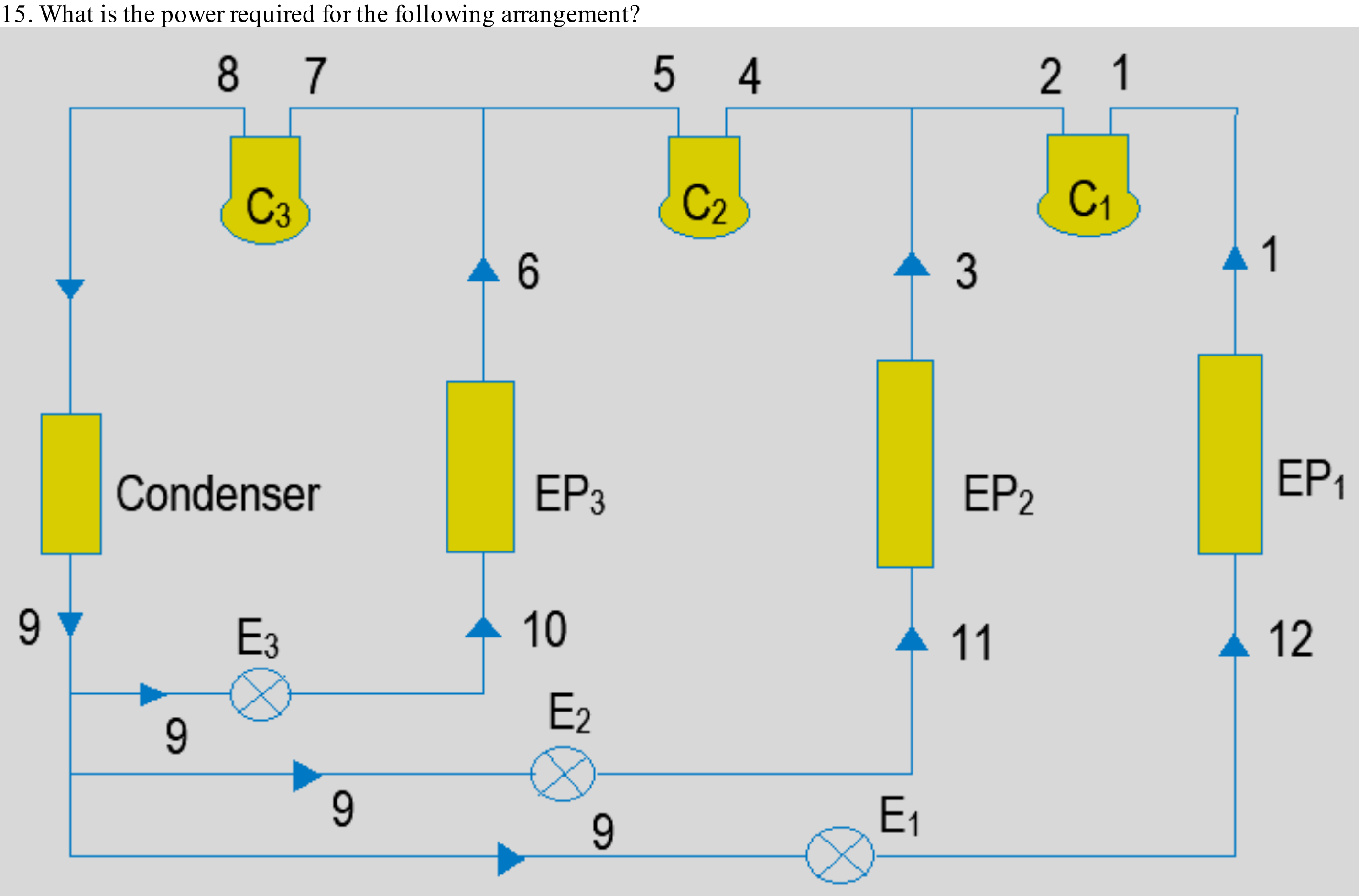
14. What is the value of enthalpy when refrigerant enters the third compressor, i.e., point 7?



a) $m_1 h_2 + m_2 h_3 / (m_1 + m_2)$
b) $m_1 h_{11} + m_2 h_8 + m_3 h_5 / (m_1$ â€“ $m_2 + m_3)$
c) $(m_1 + m_2) h_5 + m_3 h_6 / (m_1 + m_2 + m_3)$
d) $m_1 h_5 + m_2 h_5 + m_3 h_4 / (m_1 + m_2 + m_3)$

Answer: c
Explanation: Let, mass m_1, m_2 and m3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3.
Where, $m_1 = 210\ Q_1 / h_1$ â€“ h_{12}
$m_2 = 210\ Q_2 / h_2$ â€“ h_{11}
$m_3 = 210\ Q_3 / h_6$ â€“ h_{10}
At point 4, mass of refrigerant coming from evaporator 1 and 2 is converging.
So, $(m_1 + m_2 + m_3) h_7 = (m_1 + m_2) h_5 + m_3 h_6$
$h_7 = (m_1 + m_2) h_5 + m_3 h_6 / (m_1 + m_2 + m_3)$.

15. What is the power required for the following arrangement?



a) m_1 (h_2 â€“ h_{11}) + (m_1 + m_2) (h_5 â€“ h_8) + (m_1 + m_2 + m_3) (h_8 â€“ h7) / 60
b) m_1 (h_2 â€“ h_1) + (m_1 + m_2) (h_5 â€“ h_4) + (m_1 + m_2 + m_3) (h_8 â€“ h_7) / 60
c) m_1 (h_2 â€“ h_1) + (m_2 + m_3) (h_5 â€“ h_4) + (m_1 + m_2 + m_3) (h_8 â€“ h_7) / 60
d) m_1 h_5 + m_2 h_5 + m_3 h_4 / (m_1 + m_2 + m_3)

Answer: b
Explanation: Let, mass m_1, m_2 and m_3 be the mass of refrigerant circulated through evaporators EP_1, EP_2 and EP_3
So, Power required to run compressor C_1 = m_1 (h_2 â€“ h_1) / 60
Power required to run compressor C_2 = (m_1 + m_2) (h_5 â€“ h_4) / 60
Power required to run compressor C_3 = (m_1 + m_2 + m_3) (h_8 â€“ h_7) / 60
Total power required to run the system will be summation of power required to run each compressor.
Total power required to run the system = m_1 (h_2 â€“ h_1) + (m_1 + m_2) (h_5 â€“ h_4) + (m_1 + m_2 + m_3) (h_8 â€“ h_7) / 60.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œRefrigerants â€“ Physical Propertiesâ€�.

1. What is the temperature till which Freon group refrigerants remain stable?
a) 545Â°C
b) 535Â°C
c) 555Â°C
d) 565Â°C

Answer: b
Explanation: Freon group refrigerants remain stable until the temperature of 535Â°C. The temperature above this, refrigerants become unstable and by decomposing produce corrosive and poisonous products.

2. From the following refrigerants, which is one of the most stable refrigerants?
a) Ammonia
b) R â€“ 12
c) Carbon dioxide
d) Sulphur dioxide

Answer: d
Explanation: Sulphur dioxide is one of the most stable refrigerants among the given refrigerants. The temperature at which it starts decomposing is 1645Â°C. The temperature above this, Sulphur dioxide becomes unstable and by decomposing produce corrosive and poisonous products.

3. A refrigerant should show stability and inertness.
a) True
b) False

Answer: a
Explanation: To avoid the reaction of metal with the refrigerant, refrigerant should be stable and inert. If not, then the disintegration of refrigerant produces non-condensable gases which increase condenser pressure and vapour lock, which affects the operation.

4. In the presence of which of the following, Sulphur dioxide becomes corrosive?
a) R â€" 12
b) Ammonia
c) Water
d) Carbon dioxide

Answer: c
Explanation: Sulphur dioxide is non-corrosive with almost every metal, but if the water is present, then it forms sulphuric acid in the presence of water. So, Sulphur dioxide should be used where water is absent.

5. Which of the following is true about refrigerants?
a) Should be corrosive
b) Should not be stable
c) Should have high viscosity
d) Should have low viscosity

Answer: d
Explanation: As the pressure drop in the liquid and suction line is smaller, hence for refrigerant to pass through these lines should possess low viscosity for easier operation. Heat transfer through condenser and evaporator is improved by low viscosity.

6. Which of the following has the least viscosity at a liquid temperature of -15Â°C and atmospheric pressure?
a) R â€" 764
b) R â€" 744
c) R â€" 717
d) R â€" 11

Answer: c
Explanation: Among the given refrigerants, R â€" 744, i.e. Carbon dioxide has the least viscosity at given conditions, valued at 0.115 whereas, R â€" 764, R â€" 717 and R â€" 11 have liquid viscosities at given conditions as 0.503, 0.250 and 0.650.

7. Which of the following has the least viscosity at a vapour temperature of -15Â°C and atmospheric pressure?
a) R â€" 764
b) R â€" 744
c) R â€" 12
d) R â€" 11

Answer: d
Explanation: Among the given refrigerants, R â€" 11 has the least viscosity at given conditions, valued at 0.0096 whereas, R â€" 764, R â€" 744 and R â€" 12 have liquid viscosities at given conditions as 0.0111, 0.0132 and 0.0114.

8. What is the criterion to find out leakage of ammonia?
a) Solubility
b) Corrosiveness
c) Colour
d) Odour

Answer: d
Explanation: Ammonia is soluble in water and corrosive in nature, but these things have nothing to do with leakage detection. As it is a colourless gas so, the pungent odour of ammonia is the only criterion to find out the leakage in the system.

9. Which of the following has the highest thermal conductivity at a liquid temperature of 40Â°C?
a) R â€“ 22
b) R â€“ 113
c) R â€“ 12
d) R â€“ 11

Answer: d
Explanation: Among the given refrigerants, R â€“ 11 has the highest thermal conductivity at given conditions, valued at 0.1022 whereas, R â€“ 12, R â€“ 22 and R â€“ 113 have thermal conductivities at given conditions as 0.0814, 0.0970 and 0.0971. Higher thermal conductivity is desired from refrigerants for better performance.

10. Ammonia is used only with iron or steel material equipment.
a) False
b) True

Answer: b
Explanation: Ammonia is a colourless and having pungent odour. But due to corrosive property, it reacts with almost all metals and corrode them, but the intensity of corrosion is lesser in iron or steel. Hence, used with only iron or steel.

11. Which of the following has the highest thermal conductivity at the vapour temperature of 30Â°C?
a) R â€“ 22
b) R â€“ 113
c) R â€“ 12
d) R â€“ 11

Answer: a
Explanation: Among the given refrigerants, R â€“ 22 has the highest thermal conductivity at given conditions, valued at 11.784×10^{-3} whereas, R â€“ 11, R â€“ 12 and R â€“ 113 have thermal conductivities at given conditions as 8.318×10^{-3}, 9.705×10^{-3} and 7.798×10^{-3}. Higher thermal conductivity is desired from refrigerants for better performance.

12. Which of the following has the highest thermal conductivity at the vapour temperature of 0Â°C?
a) R â€“ 40
b) R â€“ 717
c) R â€“ 744
d) R â€“ 764

Answer: b
Explanation: Among the given refrigerants, R â€“ 717 has the highest thermal conductivity at given conditions, valued at 22.182×10^{-3} whereas, R â€“ 40, R â€“ 744 and R â€“ 764 have thermal conductivities at given conditions as 8.492×10^{-3}, 14.037×10^{-3} and 8.665×10^{-3}. Higher thermal conductivity is desired from refrigerants for better performance.

13. Which of the following has the highest thermal conductivity at a liquid temperature of 20Â°C?
a) R â€“ 40
b) R â€“ 717
c) R â€“ 744
d) R â€“ 764

Answer: b
Explanation: Among the given refrigerants, R â€“ 717 has the highest thermal conductivity at given conditions, valued at 0.5026 whereas, R â€“ 40, R â€“ 744 and R â€“ 764 have thermal conductivities at given conditions as 0.1612, 0.2080 and 0.3466. Higher thermal conductivity is desired from refrigerants for better performance.

14. Which of the following has the highest relative dielectric strength?
a) R â€“ 22
b) R â€“ 40
c) R â€“ 12
d) R â€“ 30

Answer: c
Explanation: Among the given refrigerants, R â€“ 12 has the highest relative dielectric strength, valued at 2.41 whereas, R â€“ 22, R â€“ 30 and R â€“ 40 have thermal conductivities at given conditions as 1.31, 1.11 and 1.06. Relative dielectric strength is the ratio of dielectric strength of nitrogen and refrigerant vapour mixture to the dielectric strength of nitrogen at room temperature and atmospheric pressure.

15. ________ is widely used in large industrial plants such as cold storages and ice plants as per the cost basis.
a) R â€“ 40
b) R â€“ 717
c) R â€“ 744
d) R â€“ 764

Answer: b
Explanation: R â€“ 717, i.e. Ammonia, is widely used as a per cost basis because it is the cheapest refrigerant. Though cost is not so important in small refrigeration capacity systems, it becomes crucial in large industries and plants. Due to the lowest cost and desirable properties, ammonia is widely used in large plants.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œRefrigerants â€“ Designation Systemâ€�.

1. What is the meaning of using two digits after the R letter?
a) The base of refrigerant
b) Number of molecules
c) Number of refrigerants in mixture
d) Number of isotopes

Answer: a
Explanation: When a number follows R, then it shows the base of refrigerant. The base is the main element in the refrigerant. So, for R â€“ 11, R â€“ 12, etc. where two digits are followed, it means these have a base as methane.

2. What is the meaning of using three digits after the R letter?
a) Methane based refrigerants
b) Number of molecules
c) Number of refrigerants in the mixture
d) Ethane based refrigerants

Answer: d
Explanation: When a number follows R, then it shows the base of refrigerant. The base is the main element in the refrigerant. So, for R â€“ 114, R â€“ 113, etc. where three digits are followed, it means these have a base as ethane.

3. What is the meaning of the last digit in three digits after R type of halo-carbon refrigerants?
a) Number of hydrogen atoms
b) Number of fluorine atoms
c) Number of carbon atoms
d) Ethane based refrigerants

Answer: b
Explanation: In the representation of writing a three-digit or ethane-based halo-carbon refrigerant the last digit from left shows the number of fluorine atoms in that refrigerant. Ex. R â€“ 113 is having three fluorine atoms, which is $C_2 Cl_3 F_3$.

4. What is the meaning of middle digit in three digits after R type of halo-carbon refrigerants?
a) Number of hydrogen atoms
b) Number of fluorine atoms
c) Number of hydrogen atoms + 1
d) Number of carbon atoms

Answer: c
Explanation: In the representation of writing a three-digit or ethane-based halo-carbon refrigerant the middle digit from left shows one more than the number of hydrogen atoms in that refrigerant. Ex: R â€“ 113 is having 0 hydrogen atoms which is $C_2 Cl_3 F_3$.

5. What is the meaning of the first digit in three digits after R type of halo-carbon refrigerants?
a) Number of hydrogen atoms + 2
b) Number of carbon atoms â€“ 1
c) Number of carbon atoms + 1
d) Number of carbon atoms

Answer: b
Explanation: In the representation of writing a three-digit or ethane-based halo-carbon refrigerant the first digit from left shows one less than the number of carbon atoms in that refrigerant. Ex: R â€“ 113 is having two carbon atoms, which is $C_2 Cl_3 F_3$.

6. Which letter is assigned to the number of hydrogen atoms in a refrigerant as per designation system?
a) m
b) n
c) p
d) q

Answer: b
Explanation: The general formula is obtained for the number of atoms of each element for methane and ethane-based refrigerants. So, as per the designation system of refrigerants number of a hydrogen atom in a refrigerant is given by letter n. It is denoted as H_n.

7. Which letter is assigned to the number of chlorine atoms in a refrigerant as per designation system?
a) m
b) n
c) p
d) q

Answer: c
Explanation: The general formula is obtained for the number of atoms of each element for methane and ethane-based refrigerants. So, as per the designation system of refrigerants number of the chlorine atom in a refrigerant is given by letter p. It is denoted as Cl_p.

8. Which letter is assigned to the number of carbon atoms in a refrigerant as per designation system?
a) m
b) n
c) p
d) q

Answer: a
Explanation: The general formula is obtained for the number of atoms of each element for methane and ethane-based refrigerants. So, as per the designation system of refrigerants number of carbon atom in a refrigerant is given by letter m. It is denoted as C_m.

9. Which letter is assigned to the number of fluorine atoms in a refrigerant as per designation system?
a) m
b) n
c) p
d) q

Answer: d
Explanation: The general formula is obtained for the number of atoms of each element for methane and ethane-based refrigerants. So, as per the designation system of refrigerants number of the fluorine atom in a refrigerant is given by letter q. It is denoted as F_q.

10. What is the general chemical formula to be fulfilled by the number of atoms present in a refrigerant?
a) $n + p + m = 2q + 2$
b) $n + p + q = 2m + 2$
c) $n + m + q = 2p + 2$
d) $m + p + q = 2n + 2$

Answer: b
Explanation: The general formula is obtained for the number of atoms of each element for methane and ethane-based refrigerants which is $n + p + q = 2m + 2$. The summation of the number of atoms of hydrogen, chlorine, and fluorine should be equal to two more than twice the number of carbon atoms in the refrigerant. This general chemical formula is crucial and is very helpful to choose the appropriate refrigerant.

11. Which of the following is the right way to represent a refrigerant number?
a) R (m â€“ 1) (n + 1) (q)
b) R (m + 1) (n + 1) (q)
c) R (m â€“ 1) (n + 1) (p)
d) R (m â€“ 1) (n + 1) (q â€“ 1)

Answer: a
Explanation: When a number follows R, then it shows the base of refrigerant. The base is the main element in the refrigerant. So, for R â€“ 114, R â€“ 113, etc. where three digits are followed, it means these have a base as ethane. Where, the first digit shows one less than the number of carbon atoms i.e., m â€“ 1. The second digit shows one more

than the number of hydrogen atoms i.e., n + 1. The third digit shows the number of fluorine atoms i.e., q. So, the correct way of representation is R (m â€“ 1) (n + 1) (q).

12. __________ based refrigerant is represented by two digits, followed by R?
a) Ethane
b) Propane
c) Ammonia
d) Methane

Answer: d
Explanation: When a number follows R, then it shows the base of refrigerant. The base is the main element in the refrigerant. So, for R â€“ 11, R â€“ 12, etc. where two digits are followed, it means these have a base as methane i.e., Methane based refrigerant is represented by two digits followed by R.

13. Dichloro-trifluoro-ethane has a refrigerant number of R-113 as per designation system.
a) False
b) True

Answer: a
Explanation: Refrigerant number of Dichloro-trifluoro-ethane i.e., $CHCl_2CF_3$ can be found by the formula of designation system,
n = 1, p = 2 and q = 3. Hence, by using n + p + q = 2m + 2, we get m = 2.
So, R (m â€“ 1) (n + 1) (q) = R (2 â€“ 1) (1 + 1) (3) = R123 = R â€“ 123.

14. Dichloro-difluoro-methane has refrigerant number of R-12 as per designation system.
a) False
b) True

Answer: b
Explanation: Refrigerant number of Dichloro-difluoro-methane i.e. CCl_2F_2 can be found by formula of designation system,
n = 0, p = 2 and q = 2. Hence, by using n + p + q = 2m + 2, we get m = 1.
So, R (m â€“ 1) (n + 1) (q) = R (1 â€“ 1) (0 + 1) (2) = R012 = R â€“ 12 as 0 can be omitted.

15. ________ refrigerants follow a formula where the molecular mass of the compound is added.
a) Halocarbon
b) Halo hydrogen
c) Inorganic
d) Azeotrope

Answer: c
Explanation: The general chemical formula for inorganic refrigerants is given by 700 + molecular mass of the compound. Ex: Ammonia is given by R â€“ 717 where 17 is the molecular mass of NH_3 so, 700 + 17 = 717.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œRefrigerant Compressors â€“ 1â€�.

1. What is the purpose of using a refrigerant compressor?
a) Raise the temperature of refrigerant
b) Reduce the temperature of refrigerant
c) Reduce the pressure of refrigerant
d) Expand the refrigerant

Answer: a
Explanation: Refrigerant compressor is multifunctional equipment used for work done. The compressor raises the temperature and pressure of the refrigerant. It also helps to circulate the refrigerant through the refrigerant system.

2. What must be the state of refrigerant entering the compressor?
a) Dry saturated vapour refrigerant
b) Dry saturated liquid refrigerant
c) Vapour and liquid mixture
d) Superheated vapour refrigerant

Answer: d
Explanation: For better performance in the refrigeration system, the refrigerant must enter the compressor in a superheated vapour state. For any other state of refrigerant, extra work is to be done to reach the condenser pressure.

This increase in work can reduce the coefficient of performance. So, the superheated state will give the best results from the refrigeration system.

3. What is the pressure at the outlet of a refrigerant compressor?
a) Critical pressure
b) Suction pressure
c) Discharge pressure
d) Backpressure

Answer: c
Explanation: The absolute pressure at which the refrigerant comes out of the compressor is called Discharge pressure. This pressure may not be equal to condenser pressure in practical systems.

4. What is the pressure at the inlet of a refrigerant compressor?
a) Critical pressure
b) Suction pressure
c) Discharge pressure
d) Backpressure

Answer: b
Explanation: The absolute pressure at which the refrigerant enters the compressor is called Suction pressure. This pressure may not be equal to evaporator pressure in practical systems.

5. Where is the reciprocating compressor mostly suitable?
a) Small displacements and low condensing pressures
b) Small displacements and high condensing pressures
c) Large displacements and low condensing pressures
d) Large displacements and high condensing pressures

Answer: b
Explanation: Reciprocating compressor is the type of compressor in which vapour refrigerant is compressed by the back and forth motion of the piston. As per the construction of piston and cylinder and for better performance as per the flow of refrigerant it is very suitable for small displacements and high condensing pressures to give the optimum refrigeration.

6. Which represents compressor ratio or pressure ratio among the following?
a) Relative discharge pressure / Relative suction pressure
b) Relative discharge pressure / Absolute suction pressure
c) Absolute discharge pressure / Relative suction pressure
d) Absolute discharge pressure / Absolute suction pressure

Answer: d
Explanation: Compressor or pressure ratio is the ratio of pressure after compression to the pressure before compression i.e., absolute pressure at discharge to the absolute pressure at suction. This can be represented as Absolute discharge pressure / Absolute suction pressure.

7. How is the compressor ratio defined in terms of volume?
a) Clearance volume / Total volume of the cylinder
b) Clearance volume / Swept volume of the cylinder
c) Total volume of cylinder / Clearance volume of the cylinder
d) Total volume of cylinder / Swept volume of the cylinder

Answer: c
Explanation: Swept volume is the volume covered by a piston in the cylinder and clearance volume is the extra space in the cylinder which is kept for easy circulation of the refrigerant. The total volume of the cylinder is the summation of swept and clearance volume. Compressor ratio is the ratio of the total volume of the cylinder to the clearance volume of the cylinder.

8. What is the formula for swept volume?
If, D = Diameter of cylinder
L = Length of the piston stroke
a) Ï€ D L
b) Ï€ D L / 2
c) Ï€ D L / 4
d) Ï€ D^2 L / 4

Answer: d
Explanation: Swept volume is the volume covered by the piston in the cylinder by back and forth motion. As we

know, Volume = Area x Length
Here, D is diameter so for a circle with diameter D area = Ï€ D^2 / 4
So, swept volume = Ï€ D^2 / 4 x L = Ï€ D^2 L / 4.

9. What is the value of the clearance factor?
If, V_C = Clearance volume and V_P = Piston displacement volume
a) V_C x V_P
b) V_C / V_P
c) V_P / V_C
d) $V_C + V_P$

Answer: b
Explanation: Piston displacement volume is the volume covered by the piston by back and forth motion in the cylinder and clearance volume is the extra space in the cylinder which is kept for easy circulation of the refrigerant. Clearance factor is the ratio of clearance volume to the piston displacement volume or swept volume.

10. What is the volume of the amount of refrigerant passing through compressor called?
a) Compressor rating
b) Compressor ratio
c) Compressor capacity
d) Compressor efficiency

Answer: c
Explanation: The volume of the actual amount of refrigerant, which passes through the compressor in unit time is called compressor capacity. It is equal to the suction volume and has unit m^3/s.

11. What the meaning of V_S ?
a) Surface volume
b) Suction volume
c) Swept volume
d) Secondary piston volume

Answer: b
Explanation: The volume of the refrigerant sucked by the compressor in the suction stroke is called suction volume. Suction volume is denoted by V_S . And swept volume is the piston displacement volume, which is denoted by V_P .

12. What is the volumetric efficiency?
a) V_P / V_S
b) V_C / V_S
c) V_S / V_C
d) V_S / V_P

Answer: d
Explanation: Volumetric efficiency is the ratio of the compressor capacity or the suction volume to the piston displacement volume. So, volumetric efficiency is represented as V_S / V_P . A good compressor has a volumetric efficiency of around 70 â€“ 80 %.

13. Clearance volume can be zero.
a) False
b) True

Answer: a
Explanation: Though it is possible in ideal conditions, a cylinder with no clearance volume will have very less efficiency due to contamination of newly entering and outgoing refrigerant in the cylinder. Optimum compression will not be possible without clearance volume. Volumetric efficiency will be affected if $V_C = 0$. It is a very crucial parameter to have and to get optimum results in the refrigeration system.

14. Mixture of liquid and vapour state of refrigerant reduces overall work done.
a) False
b) True

Answer: a
Explanation: Dry saturated vapour or superheated vapor state of refrigerant is desired when entering the compressor. If the mixture enters the compressor, then the compressor has to covert the liquid to vapour and later compress the vapour refrigerant till the desirable pressure near to the condenser pressure. So, overall work is increased, and this will affect the C.O.P. of the system.

15. Pressure or compression ratio is always ___________
a) equal to one
b) less than one
c) greater than one
d) zero

Answer: c
Explanation: Compression or pressure ratio is the ratio of pressure after compression to the pressure before compression i.e., absolute pressure at discharge to the absolute pressure at suction. This can be represented as Absolute discharge pressure / Absolute suction pressure. As the discharge pressure is always more than suction pressure, the value of the compression ratio will always be greater than unity.

This set of Refrigeration Objective Questions & Answers focuses on â€œRefrigerant Compressors â€“ 2â€�.

1. What is the work done during an isothermal compression?
a) 2.3 $mRT_1 \ln (p_2 / p_1)$
b) 2.3 $mRP_1 \ln (p_2 / p_1)$
c) 2.3 $mRT_1 \ln (p_1 / p_2)$
d) $mRT_1 \ln (p_2 / p_1)$

Answer: d
Explanation: Isothermal process is the process in which temperature remains constant and represented by PV = C. Work done is the area under the curve on PV chart. So, for isothermal process the work done is given by = $p_1 v_1 \ln (v_1 / v_2)$ as by ideal gas equation we can replace PV = mRT and v_1 / v_2 by p_2 / p_1 which is called as compression ratio.
Work done = $mRT_1 \ln (p_2 / p_1)$ or 2.3 $mRT_1 \log (p_2 / p_1)$.

2. What is the work done during a polytropic compression?
a) [n / (n â€“ 1)] mR (T_2 â€“ T_1)
b) [n / (n + 1)] mR (T_2 â€“ T_1)
c) [n / (n â€“ 1)] mR ($T_2 + T_1$)
d) [n / (n + 1)] mR ($T_2 + T_1$)

Answer: a
Explanation: Polytropic process is represented by $PV^n = C$ and where n = polytropic index. Work done is the area under the curve on PV chart. So, for polytropic process the work done by using ideal gas equation PV = mRT and v_1 / v_2 by p_2 / p_1 which is called as compression ratio.
Work done = [n / (n â€“ 1)] mR (T_2 â€“ T_1).

3. What is the work done during an isentropic compression?
a) [n / (n â€“ 1)] mR (T_2 â€“ T_1)
b) [n / (n + 1)] mR (T_2 â€“ T_1)
c) [n / (n â€“ 1)] mR ($T_2 + T_1$)
d) [n / (n + 1)] mR ($T_2 + T_1$)

Answer: a
Explanation: Polytropic process is represented by $PV^n = C$ and where n = polytropic index. Work done is the area under the curve on PV chart. So, for polytropic process the work done by using ideal gas equation PV = mRT and v_1 / v_2 by p_2 / p_1 which is called as compression ratio.
Work done = [n / (n â€“ 1)] mR (T_2 â€“ T_1).

4. What is the expression for optimum intercooler or intermediate pressure P_2 if the cooling ratio is fixed in a compound compression refrigeration system with intercooling?

a) $P_2 = P_1 / P_3$
b) $P_2 = P_3 / P_1$
c) P_2 = âˆšP $_1$ x P_3
d) P_2 = âˆ›P $_1$ x P_3

Answer: c
Explanation: Putting (n / n â€“ 1) = k and dW / dP_2 = 0 we get,
$T_1 P_2^{k}$ â€“ ^{1} / $P_1^{k} = T_3 P_3^{k} / P_2^{k + 1}$
For the given conditions $T_1 = T_3$,
P_2 x P_2 = P_1 x P_3
P_2 = âˆšP $_1$ x P_3 .

5. Where is the centrifugal compressor mostly suitable?
a) Small displacements and low condensing pressures
b) Small displacements and high condensing pressures
c) Large displacements and low condensing pressures
d) Large displacements and high condensing pressures

Answer: c
Explanation: Centrifugal compressor is the type of compressor in which in the simplest form consists of an impeller to which a number of curved vanes are fitted symmetrically. As per the construction, the impeller rotates in an airtight volute casing with inlet and outlet points, and for better performance as per the flow of refrigerant, it is very suitable for larger displacements and low condensing pressures to give the optimum refrigeration.

6. Where is the reciprocating compressor mostly suitable?
a) Small displacements and low condensing pressures
b) Small displacements and high condensing pressures
c) Large displacements and low condensing pressures
d) Large displacements and high condensing pressures

Answer: b
Explanation: Reciprocating compressor is the type of compressor in which vapor refrigerant is compressed by the back and forth motion of the piston. As per the construction of piston and cylinder and for better performance as per the flow of refrigerant it is very suitable for small displacements and high condensing pressures to give the optimum refrigeration.

7. What is the value of swept volume?
If, D = 10 mm
L = 6 mm
a) 188.49
b) 94.2477
c) 47.1238
d) 471.23

Answer: d
Explanation: Swept volume is the volume covered by the piston in the cylinder by back and forth motion. As we know, Volume = Area x Length
Here, D is diameter so for a circle with diameter D area = Ï€ D^2 / 4
So, swept volume = Ï€ D^2 / 4 x L = Ï€ D^2 L / 4 = Ï€ x 10 x 10 x 6 / 4 = 471.23.

8. What is the value of the clearance factor?
If, $V_C = 0.137$ and $V_P = 0.034$
a) 0.00465
b) 0.0465
c) 4.029
d) 0.2481

Answer: c
Explanation: Piston displacement volume is the volume covered by the piston by back and forth motion in the cylinder and clearance volume is the extra space in the cylinder which is kept for easy circulation of the refrigerant. Clearance factor is the ratio of clearance volume to the piston displacement volume or swept volume.
Clearance factor = $V_C / V_P = 0.137 / 0.034 = 4.029$.

9. What is the value of volumetric efficiency?
$V_C = 0.445$, $V_S = 0.843$ and $V_P = 1.087$
a) 1.289
b) 0.5278
c) 1.894
d) 0.775

Answer: d
Explanation: Volumetric efficiency is the ratio of the compressor capacity or the suction volume to the piston displacement volume. So, volumetric efficiency is represented as V_S / V_P. A good compressor has a volumetric efficiency of around 70 â€“ 80 %.
$V_S / V_P = 0.843 / 1.087 = 0.775 = 77.5$ %.

10. The main disadvantage of centrifugal compressors is surging.
a) False
b) True

Answer: b
Explanation: When refrigeration load decreases due to the reversal flow of refrigerant from compressor to the evaporator and causes stress conditions in the compressor, this phenomenon is called surging which occurs in these types of compressors and is one of the disadvantages.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œTypes of Refrigerant Compressorsâ€�.

1. Where is the reciprocating compressor mostly suitable?
a) Small displacements and low condensing pressures
b) Small displacements and high condensing pressures
c) Large displacements and low condensing pressures
d) Large displacements and high condensing pressures

Answer: b
Explanation: Reciprocating compressor is the type of compressor in which vapour refrigerant is compressed by the back and forth motion of the piston. As per the construction of piston and cylinder and for better performance as per the flow of refrigerant it is very suitable for small displacements and high condensing pressures to give the optimum refrigeration.

2. Where is the centrifugal compressor mostly suitable?
a) Small displacements and low condensing pressures
b) Small displacements and high condensing pressures
c) Large displacements and low condensing pressures
d) Large displacements and high condensing pressures

Answer: c
Explanation: Centrifugal compressor is the type of compressor in which in the simplest form consists of an impeller to which a number of curved vanes are fitted symmetrically. As per the construction, the impeller rotates in an airtight volute casing with inlet and outlet points, and for better performance as per the flow of refrigerant, it is very suitable for larger displacements and low condensing pressures to give the optimum refrigeration.

3. The main advantage of centrifugal compressors is surging.
a) False
b) True

Answer: a
Explanation: When refrigeration load decreases due to the reversal flow of refrigerant from compressor to the evaporator and causes stress conditions in the compressor, this phenomenon is called surging which occurs in these types of compressors and is one of the disadvantages.

4. What is the required condenser and evaporator pressure ratio for reciprocating compressors?
a) > 1.5 bar
b) < 1.5 bar
c) 1 bar
d) > 3.5 bar

Answer: d
Explanation: Reciprocating compressor is the type of compressor in which vapour refrigerant is compressed by the

back and forth motion of the piston. For optimum operation and effective results, the ratio of condenser and evaporator pressure should be greater than 3.5 bar.

5. What is the required condenser and evaporator pressure ratio for rotary compressors?
a) > 1.5 bar
b) < 1.5 bar
c) 1 bar
d) > 3.5 bar

Answer: a
Explanation: Rotary compressor is the type of compressor in which vapour refrigerant is compressed by the movement of blades and have positive displacement. For optimum operation and effective results, the ratio of condenser and evaporator pressure should be greater than 1.5 bar.

6. What is the required condenser and evaporator pressure ratio for centrifugal compressors?
a) > 1.5 bar
b) < 1.5 bar
c) 1 bar
d) > 3.5 bar

Answer: b
Explanation: Centrifugal compressor is the type of compressor in which in the simplest form consists of an impeller to which a number of curved vanes are fitted symmetrically. For optimum operation and effective results, the ratio of condenser and evaporator pressure should be less than 1.5 bar.

7. Which of the following is the condition to use two compressors in the refrigeration system?
a) The desired temperature is 3Â°C
b) The desired temperature is -3Â°C
c) The desired temperature is -50Â°C
d) The desired temperature is -5Â°C

Answer: c
Explanation: So as to get very low temperature, the compressor has to do more work. So, for the given conditions if the desired temperature is -50Â°C then use of two compressors is advised.

8. Centrifugal compressors are used to handle _______ volume of refrigerant.
a) small
b) medium
c) large
d) very large

Answer: c
Explanation: Centrifugal compressors do not have parts like valves, pistons, etc. just impeller and casing. Centrifugal compressor has negligible clearance volume due to the construction and hence has large volumetric efficiency. Compressor runs at higher speeds and handles a large volume of vapour refrigerant.

9. Reciprocating compressors are used to handle _______ volume of refrigerant.
a) small
b) medium
c) large
d) very large

Answer: a
Explanation: Reciprocating compressors have parts like valves, pistons, and cylinders and have larger clearance volume than other compressors to get smooth operation. Due to the presence of more parts and relatively higher clearance volume, it can handle a small volume of vapour refrigerant.

10. Centrifugal compressors are more stable than reciprocating in terms of operation.
a) False
b) True

Answer: b
Explanation: Centrifugal compressors do not have parts like valves, pistons, etc. just impeller and casing. Due to fewer parts operating at the same time, there are no unbalanced masses hence compressor operates with lesser vibrations and remains quiet too. Hence, Centrifugal compressors are more stable than reciprocating in terms of operation.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œCondensers and Cooling Towers â€“ 1â€�.

1. What is the purpose of using a condenser?
a) To absorb heat
b) To reject heat
c) To convert liquid refrigerant to vapor refrigerant
d) To convert solid refrigerant to vapor refrigerant

Answer: b
Explanation: Condenser is used to convert vapor refrigerant discharging from the compressor into liquid refrigerant by rejecting or removing heat and attaining the saturated liquid line for the refrigerant.

2. Which of the following is not the criterion for the selection of the condenser?
a) The capacity of the condenser
b) Type of refrigerant used
c) Type of cooling medium available
d) Type of compressor and evaporator used

Answer: d
Explanation: For the selection of the condenser, there is no effect of the type of compressor and evaporator used in the system. The capacity, type of refrigerant used, and type of cooling medium available play a crucial role in the selection.

3. What is the expression for the load on the condenser?
a) $Q_C = R_E + W$
b) $Q_C = R_E$ â€“ W
c) $Q_C = R_E \times W$
d) $Q_C = R_E / W$

Answer: a
Explanation: The load on the condenser, i.e., Q_C is the summation of refrigeration capacity and work done by the compressor. Hence, it is given by
$Q_C = R_E + W$
Where, Q_C = Load on the condenser, R_E = Refrigeration capacity & W = Work done by the compressor.

4. What is the expression for the heat rejection factor?
a) $HRF = W / R_E$
b) $HRF = R_E / W$
c) $HRF = Q_C / R_E$
d) $HRF = R_E / Q_C$

Answer: c
Explanation: Heat rejection factor is the load on the condenser per unit refrigeration capacity. So, it can be represented as,
$HRF = Q_C / R_E$, Where, Q_C = Load on the condenser & R_E = Refrigeration capacity.

5. What is the expression for the heat rejection factor in terms of C.O.P.?
a) 1 + C.O.P.
b) 1 â€“ C.O.P.
c) 1 â€“ 1 / C.O.P.
d) 1 + 1 / C.O.P.

Answer: d
Explanation: Heat rejection factor is the load on the condenser per unit refrigeration capacity. So, it can be represented as,
$HRF = Q_C / R_E$, Where, Q_C = Load on the condenser & R_E = Refrigeration capacity
And as we know, the load on the condenser, i.e., Q_C is the summation of refrigeration capacity and work done by the compressor.
$Q_C = R_E + W$
Hence, $HRF = Q_C / R_E = R_E + W / R_E = 1 + W / R_E = 1 + 1 /$ C.O.P. (as C.O.P. $= R_E / W$).

6. Which of the following does not affect the refrigeration capacity of the condenser?
a) Material
b) Amount of contact
c) Temperature difference
d) Type of refrigerant

Answer: d
Explanation: Condenser capacity is not affected by the type of refrigerant. Material is affected due to the ability of different material to reject heat differs and affect the capacity. By varying the amount of contact, rate of flow of condensing medium is varied and hence affects the capacity. Heat transfer of condenser depends upon the temperature difference between condensing medium and vapour refrigerant and affects the heat transfer rate. So, the type of refrigerant used has nothing to do with the condenser capacity.

7. Materials form deposits inside the condenser water tubes is called _______
a) water rusting
b) water corrosion
c) water fouling
d) water failing

Answer: c
Explanation: The water contains a certain amount of minerals and foreign materials when used in water-cooled condensers. These minerals depend upon the source. These materials start to form deposit inside the condenser water tubes is called water fouling.

8. Which of the following is not the effect of water fouling?
a) Increase in heat transfer rate
b) Tube insulation
c) Reduction in heat transfer rate
d) Restrict water flow

Answer: a
Explanation: The water contains a certain amount of minerals and foreign materials when used in water-cooled condensers. These minerals depend upon the source. These materials start to form deposits inside the condenser water tubes is called water fouling. These deposits insulate the tube, reduce the heat transfer rate, and restrict the water flow but do not increase the heat transfer rate at any condition.

9. What is the fouling factor?
a) Heat transfer coefficient
b) 1 / Heat transfer coefficient
c) \(\sqrt{Heat \,transfer \,coefficient}\)
d) 1 / (Heat transfer coefficient)^{2}

Answer: b
Explanation: The water contains a certain amount of minerals and foreign materials when used in water-cooled condensers. These minerals depend upon the source. These materials start to form deposit inside the condenser water tubes is called water fouling. These deposits insulate the tube, reduce the heat transfer rate, and restrict the water flow but do not increase the heat transfer rate at any condition. So, the fouling factor is the reciprocal of the heat transfer coefficient for the material of scale. Ex: For copper tubes and R â€“ 12 its is valued at 0.000095 m^{2} s K/J.

10. The initial cost of the air-cooled condenser is high.
a) False
b) True

Answer: a
Explanation: As the name suggests, the air-cooled condenser is the one in which the removal of heat is carried out by air. As the construction of this type of condenser is very simple, just tubing and different type of fins; hence, the initial cost is less, and even maintenance cost is less.

This set of Refrigeration Questions & Answers for Exams focuses on â€œCondensers and Cooling Towers â€“ 2â€�.

1. What is the pressure side of a refrigerating system in which condenser is used?
a) Low pressure
b) Zero pressure
c) Negative pressure
d) High pressure

Answer: d
Explanation: Condenser is used to convert vapor refrigerant discharging from the compressor into liquid refrigerant by rejecting heat. So, it is used on the high-pressure side to do the conversion. At discharge pressure after compression, condensation is carried out.

2. What is the optimum temperature difference in Celsius for the operation of most air-cooled condensers and designed based on this difference?
a) 10
b) 14
c) 20
d) 28

Answer: b
Explanation: Heat transfer of condenser depends upon the temperature difference between the condensing medium and vapor refrigerant and affects the heat transfer rate. So, air-cooled condensers are designed for the temperatures difference of 14â�°C for the optimum heat transfer rate and smooth and hassle-free operation.

3. What of the following uses natural convection air-cooled condensers?
a) Domestic refrigerators
b) High capacity room air conditioners
c) High capacity water coolers
d) Industrial air conditioners

Answer: a
Explanation: Natural convection phenomenon is used to carry out the operation. Large surface area is required for the proper heat transfer between the mediums. Due to the slow process and able to handle low capacity used just in small-capacity applications like domestic refrigerators.

4. Which of the following is true about shell and coil condensers?
a) water flows in the shell and refrigerant in the coil
b) refrigerant flows in the shell and water in the coil
c) water and refrigerant flow in the coil
d) water and refrigerant flow in the shell

Answer: b
Explanation: Shell and coil condensers consists of one or more water coils enclosed in the welded steel shell through which refrigerant flows. So, the refrigerant flows in the shell, and water in the coil is the perfect construction of this type of condenser.

5. What is the material of tubes used for shell and tube condenser in ammonia refrigeration system?
a) Aluminum
b) Brass
c) Steel
d) Copper

Answer: c
Explanation: As ammonia is toxic and has the ability to rust the material which comes in the contact. So, in the ammonia refrigeration system, steel tubes are used for shell and tube condensers to avoid the corrosion.

6. What is the condensing medium used in evaporative condensers?
a) air only
b) water only
c) ammonia
d) air and water

Answer: d
Explanation: Evaporative condenser uses air and water as a condensing medium. This type of condenser does the combined work of water-cooled condenser and cooling water, and hot vapor is condensed into a liquid refrigerant.

7. What is the value of Heat Rejection Factor if the C.O.P. 4.28?
a) 5.28
b) -3.28
c) 1.233
d) 0.766

Answer: c
Explanation: Heat rejection factor is the load on the condenser per unit refrigeration capacity. So, it can be represented as,

HRF = Q_C / R_E, Where, Q_C = Load on the condenser & R_E = Refrigeration capacity
And as we know, the load on the condenser, i.e., Q_C is the summation of refrigeration capacity and work done by the compressor.
$Q_C = R_E + W$
Hence, HRF = $Q_C / R_E = R_E + W / R_E = 1 + W / R_E = 1 + 1$ / C.O.P. (as C.O.P. = R_E / W)
HRF = 1 + 1 / 4.28 = 1.233.

8. What is the value of HRF if Work is 10 kW and refrigeration capacity is 40 kW?
a) 1.25
b) 0.25
c) 0.75
d) 1

Answer: a
Explanation: Heat rejection factor is the load on the condenser per unit refrigeration capacity. So, it can be represented as,
HRF = Q_C / R_E, Where, Q_C = Load on the condenser & R_E = Refrigeration capacity
And as we know, the load on the condenser, i.e., Q_C is the summation of refrigeration capacity and work done by the compressor.
$Q_C = R_E + W$
Hence, HRF = $Q_C / R_E = R_E + W / R_E = 1 + W / R_E = 1 + 1$ / C.O.P. (as C.O.P. = R_E / W)
HRF = 1 + (10 / 40) = 1 + 0.25 = 1.25.

9. Air-cooled condensers operate on lower condensing temperatures than water-cooled condensers.
a) False
b) True

Answer: a
Explanation: The main advantage of air-cooled condensers is that they operate at higher condensing temperatures than water-cooled condensers. Due to this high temperature, the compressor has to do more work and might affect C.O.P. in some conditions.

10. The HRF for R â€“ 12 with condensing temperature and evaporator temperature as 40Â°C and 5Â°C respectively is 1.5.
a) True
b) False

Answer: b
Explanation: HRF depends on C.O.P. as HRF = $Q_C / R_E = R_E + W / R_E = 1 + W / R_E = 1 + 1$ / C.O.P. and as C.O.P. is affected by condenser and evaporator temperature. So, for the given conditions, the value of the Heat Rejection Factor for R â€“ 12 at condensing temperature and evaporator temperature as 40Â°C and 5Â°C respectively is 1.25.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œCondensers â€“ Cooling Towersâ€�.

1. Which of the following cooling towers possess maximum heat transfer from air to water?
a) Natural Draft
b) Mechanical Draft
c) Natural and Mechanical Draft
d) Atmospheric Draft

Answer: b
Explanation: Natural Draft is where air circulates naturally without any external force, and the atmospheric draft is a type of natural draft. So, the mechanical draft is the type of cooling tower which gives the maximum heat transfer due to usage of fans for the circulation. More the force more heat can be transferred.

2. How is the performance of the cooling tower indicated?
a) Wet-bulb temperature
b) Dry bulb temperature
c) Approach
d) Range

Answer: c
Explanation: Approach can be defined as the temperature difference between water leaving the cooling tower and

ambient wet-bulb temperature. If the approach is low, then the performance is good and vice-versa. This approach value denotes how close the cooling tower gets the water to the wet-bulb temperature of the ambient or surrounding air.

3. What is the difference between the temperature of entering and leaving water in the cooling tower?
a) Wet-bulb temperature
b) Dry bulb temperature
c) Approach
d) Range

Answer: d
Explanation: Range can be defined as the difference between entering water temperature and leaving water temperature. This is also an indicator of the performance of cooling tower but for the effective performance, a better indicator, i.e., the approach is used.

4. What is the formula for the effectiveness of cooling tower from the following?
a) Range / (Range + Approach)
b) Approach / (Range + Approach)
c) Range / Approach
d) Approach / Range

Answer: a
Explanation: Approach can be defined as the temperature difference between water leaving the cooling tower and ambient wet-bulb temperature. The range can be defined as the difference between entering water temperature and leaving water temperature.
Hence, the effectiveness can be given as,
Effectiveness = Range / (Range + Approach).

5. A cooling tower brings water temperature to __________
a) WBT
b) DBT
c) DPT
d) Ambient WBT

Answer: d
Explanation: Approach can be defined as the temperature difference between water leaving the cooling tower and ambient wet-bulb temperature. If the approach is low, then the performance is good and vice-versa. This approach value denotes how close the cooling tower gets the water to the wet-bulb temperature of the ambient or surrounding air. So, cooling tower brings the water temperature to ambient wet bulb temperature for the operation.

6. What is the correct representation of range from the following?
a) Range = Cooling tower water outlet temperature â€“ Wet bulb temperature
b) Range = Cooling tower water inlet temperature â€“ Wet bulb temperature
c) Range = Cooling tower water outlet temperature â€“ Dry bulb temperature
d) Range = Heat load in kcal per hour / Water circulation in liters per hour

Answer: d
Explanation: Range can be defined as the difference between entering water temperature and leaving water temperature. It is also defined as the heat load per water circulation. As in the given options, the first three are incorrect as one of them represents approach so correct representation is,
Range = Heat load in kcal per hour / Water circulation in liters per hour
Range = Cooling tower water inlet temperature â€“ Cooling tower water outlet temperature.

7. What is L / G in terms of the cooling tower?
a) Length / Girth
b) Length / Gradient
c) Air mass flow rate / Water flow rate
d) Water flow rate / Air mass flow rate

Answer: d
Explanation: The L / G is called a liquid-gas ratio. It is defined as the ratio of water flow rate to the air mass flow rate in the cooling tower. This L / G ratio affects the effectiveness of the cooling tower.

8. Mechanical draft cooling tower size is ________ the size of the natural draft cooling tower.
a) smaller than
b) larger than
c) equal to the
d) very much larger than

Answer: a
Explanation: The mechanical draft cooling towers are smaller in size than that of the natural draft cooling towers with the same capacity due to the fact that a large volume of forced air increases the cooling capacity.

9. The cooling capacity of mechanical draft cooling towers cannot be varied.
a) False
b) True

Answer: a
Explanation: The main advantage of mechanical draft cooling towers is cooling capacity can be controlled. This can be achieved by controlling the amount of forced air entering the cooling tower.

10. Mechanical Draft cooling towers do not depend on atmospheric air.
a) True
b) False

Answer: a
Explanation: One of the advantages of mechanical draft cooling towers is that they do not depend upon the atmospheric air. Fans do the operation. Due to the fact of independence, this type of cooling towers can be even installed inside the building.

This set of Refrigeration online quiz focuses on â€œEvaporators Types, Factors Affecting it and Defrosting Methodsâ€�.

1. Why is the evaporator used?
a) To improve C.O.P.
b) To decrease the refrigeration effect
c) To absorb heat
d) To reject heat

Answer: c
Explanation: Evaporator is used to absorb the heat from the medium being cooled and get the refrigeration effect. Multiple evaporators are used to enhance the refrigeration effect and eventually the C.O.P. too.

2. What is the pressure side of a refrigerating system in which evaporator is used?
a) Low pressure
b) Zero pressure
c) Negative pressure
d) High pressure

Answer: a
Explanation: Evaporator is used to convert liquid refrigerant into vapor refrigerant by absorbing heat. The liquid coming from the expansion valve is converted into vapor and forwarded to the compressor for compression. Evaporator gives the refrigeration effect. So, it is used on the lower pressure side to provide input for the compressor.

3. Evaporator is also called as Freezing, cooling or chilling coil.
a) False
b) True

Answer: b
Explanation: Evaporator is used to convert liquid refrigerant into vapor refrigerant by absorbing heat. The liquid coming from the expansion valve is converted into vapor and forwarded to the compressor for compression. Evaporator gives the refrigeration effect. So, it is also called a Freezing, cooling, or chilling coil.

4. What evaporator does to the refrigerant coming from expansion valve in terms of state?
a) high-pressure liquid refrigerant
b) low-pressure liquid and vapor refrigerant
c) low-pressure vapor refrigerant
d) high-pressure vapor refrigerant

Answer: b
Explanation: The liquid coming from the expansion valve is converted into vapor and forwarded to the compressor for compression. So, the evaporator absorbs the heat, and phase change occurs. There is a slight change in pressure but negligible. Thus, the state of refrigerant changes from low-pressure liquid to low-pressure vapor.

5. What is the formula for the capacity of evaporator?
a) $Q = U A^2 (T_2$ â€“ $T_1)$

b) Q = U A (T_2 â€“ T_1)
c) Q = A (T_2 â€“ T_1)
d) Q = U (T_2 â€“ T_1)

Answer: b
Explanation: Capacity of the evaporator is the amount of heat absorbed by it over a given period of time. So, the heat absorbed or capacity is the heat convection, can be given as,
Q = U A (T_2 â€“ T_1), where U is overall heat transfer coefficient, A is the surface area of the evaporator and T_1 & T_2 are the saturation temperature of refrigerant and temperature of the medium to be cooled respectively.

6. Which of the following is not a factor affecting the capacity of evaporator?
a) Velocity of refrigerant
b) The thickness of the evaporator coil wall
c) Material
d) Evaporator pressure

Answer: d
Explanation: Capacity of the evaporator is the amount of heat absorbed by it over a given period of time. Increase in the velocity can increase the heat transfer up to a certain extent. The thickness of the coil wall affects the convection, and hence capacity can be changed. The material should be a good conductor to get optimum heat transfer. Hence, evaporator pressure does not affect the capacity, but the temperature does have.

7. What is the value of the fluid side heat transfer coefficient when liquid flows through the evaporator shell?
a) C x m
b) C x $(m)^{0.5}$
c) C x $(m)^{2}$
d) C x $(m)^{3}$

Answer: b
Explanation: Fluid side heat transfer coefficient is denoted as h_f and has a formula,
h_f = [(CK / D) (V DÏ� / Î¼)$^{0.8}$ (C_p Î¼ / K)$^{0.4}$] W / m^2 K
So, for liquid flowing through the shell, the value is h_f = C x $(m)^{0.5}$ = C x âˆšm.

8. What is the value of fluid side heat transfer coefficient when air flows over finned coil by forced convection?
a) C x $(m)^{0.1}$
b) C x $(m)^{0.2}$
c) C x $(m)^{0.3}$
d) C x $(m)^{0.4}$

Answer: d
Explanation: Fluid side heat transfer coefficient is denoted as h_f and has a formula,
h_f = [(CK / D) (V D Ï� / Î¼)$^{0.8}$ (C_p Î¼ / K)$^{0.4}$] W / m^2 K
So, for air flowing over finned coil by forced convection, the value is h_f = C x $(m)^{0.4}$

9. What is the value of the fluid side heat transfer coefficient when air flows over cold pipes by natural convection?
a) 0.2 (T_a â€“ T_m / D)$^{1/4}$
b) 0.2 (T_a â€“ T_m / D)
c) 0.2 (T_a â€“ T_m / D)$^{1/3}$
d) 0.2 (T_a â€“ T_m / D)$^{1/2}$

Answer: a
Explanation: Fluid side heat transfer coefficient is denoted as h_f and has a formula,
h_f = [(CK / D) (V D Ï� / Î¼)$^{0.8}$ (C_p Î¼ / K)$^{0.4}$] W / m^2 K
So, for air flowing over cold pipes by natural convection, the value is h_f = 0.2 (T_a â€“ T_m / D)$^{1/4}$

10. The bare tube evaporators are called as _______ evaporators.
a) extended surface
b) bare surface
c) pipe surface
d) prime surface

Answer: d
Explanation: The bare tube evaporators are also known as prime surface evaporators due to the simple construction of it. The bare tube coil is easy to clean and defrost; hence, it is called prime surface evaporator.

11. Which type of evaporator is generally used in home freezers, ice cream cabinets, etc?
a) Shell and coil evaporator
b) Finned evaporator
c) Shell and tube evaporator
d) Plate evaporator

Answer: d
Explanation: Plate evaporators are generally used in home freezers, ice cream cabinets, beverage coolers, and locker plants, etc. In this type of evaporator, coils are either welded on one side of the plate or between two plates which are welded together at the edges.

12. Which type of evaporator is generally used for wine cooling and chilling oil in the petroleum industry?
a) Tube-in-tube evaporator
b) Finned evaporator
c) Shell and tube evaporator
d) Plate evaporator

Answer: a
Explanation: Tube-in-tube evaporators are used for wine cooling and chilling oil in the petroleum industry. In this type of evaporator, one tube is inside another tube. It provides a high heat transfer rate.

13. Which type of evaporator is used in household refrigerators?
a) frosting evaporator
b) defrosting evaporator
c) non-frosting evaporator
d) non-corrosive evaporator

Answer: a
Explanation: Evaporators used in household refrigerators, low-temperature evaporators, and bare pipe coils in storage boxes come under frosting type. These operate at temperature always below 0Â°C. Coils frost continuously and need to be defrosted at regular interval of time.

14. Which type of evaporator is generally used to cool drinking water?
a) Shell and tube evaporator
b) Finned evaporator
c) Shell and coil evaporator
d) Plate evaporator

Answer: c
Explanation: The shell and coil evaporators are the dry expansion evaporators used to chill water. The shell may be sealed or open. If the shell is sealed, then it is used for cooling drinking water.

15. Finned evaporators are also known as prime surface evaporators.
a) False
b) True

Answer: a
Explanation: Finned evaporators are the ones which use a number of fins to increase the contact surface for heat transfer. The specifications of fins depend on the required heat transfer rate. As fins are the extended material used for heat transfer enhancement so, finned evaporators are also called as extended surface evaporators whereas, bare tube coil evaporators are called as prime surface evaporators.

This set of Refrigeration Multiple Choice Questions & Answers (MCQs) focuses on â€œRefrigerant Compressors â€“ Multi â€“ Stage Compressionâ€�.

1. Why is multi-stage compression used?
a) To improve C.O.P.
b) To decrease the refrigeration effect

c) To increase work
d) To increase leakage loss

Answer: a
Explanation: By expanding the refrigerant very close to the saturated liquid state refrigeration effect can be improved. And if the refrigerant is compressed very near to the saturated vapour line by using compression in more stages, overall work can be reduced. The relative decrease in the overall work done increases the C.O.P. of the system.

2. What is the expression for optimum intercooler or intermediate pressure P_2 if the cooling ratio is fixed in a compound compression refrigeration system with intercooling?
a) $P_2 = P_1 / P_3$
b) $P_2 = P_3 / P_1$
c) $P_2 =$ âˆšP_1 x P_3
d) $P_2 =$ âˆ›P_1 x P_3

Answer: c
Explanation: Putting (n / n â€“ 1) = k and dW / dP_2 = 0 we get,
$T_1 P_2$ ^{k} â€“ ^{1} / P_1 k = $T_3 P_3^{k} / P_2^{k+1}$
For the given conditions $T_1 = T_3$,
P_2 x $P_2 = P_1$ x P_3
$P_2 =$ âˆšP_1 x P_3 .

3. Multistage compression provides effective lubrication.
a) False
b) True

Answer: b
Explanation: Due to the use of high-pressure compression by a single-cylinder, there are chances of obtaining very high discharge temperatures which might heat the cylinder head or burn the lubricating oil. So, with multistage burning of lubricating oil can be avoided as the discharge temperature will be lower. Hence, Multistage compression provides effective lubrication.

4. What is the value of optimum intermediate pressure is the cooling ratio is fixed in a compound VCR with intercooling having suction and discharge pressure as 2 and 8 bar respectively?
a) 2 bar
b) 4 bar
c) 6 bar
d) 8 bar

Answer: b
Explanation: Putting (n / n â€“ 1) = k and dW / dP_2 = 0 we get,
$T_1 P_2$ ^{k} â€“ ^{1} / $P_1^{k} = T_3 P_3^{k} / P_2^{k+1}$
For the given conditions $T_1 = T_3$,
P_2 x $P_2 = P_1$ x P_3
$P_2 =$ âˆšP_1 x P_3
= âˆš2 x 8
= 4 bar.

5. Which of the following is not true about single-stage compression?
a) Size of the cylinder is very large
b) Difficult to reject a good amount of heat in a lesser time of compression
c) Volumetric efficiency will be low
d) Safe at a higher temperature

Answer: d
Explanation: As a single cylinder is used so for effective results large size cylinder will be used. Less time of compression and relatively volumetric efficiency will be lower. Due to the use of high-pressure compression by a single-cylinder, there are chances of obtaining very high discharge temperatures which might heat the cylinder head or burn the lubricating oil. Hence, it might not be safe in every situation.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometric Termsâ€�.

1. What is the mixture of a number of gases?
a) Moist air
b) Dry air
c) Fresh air
d) Saturated air

Answer: b
Explanation: Dry air is the mixture of a number of gases like nitrogen, oxygen, carbon dioxide, hydrogen, etc. These gases have different proportion in this mixture by which the properties may alter.

2. Which of the following has the maximum contribution in the dry air?
a) Nitrogen
b) Argon
c) Carbon dioxide
d) Hydrogen

Answer: a
Explanation: Dry air is the mixture of a number of gases like nitrogen, oxygen, carbon dioxide, hydrogen, etc. In this mixture, nitrogen has the maximum contribution. Nitrogen is approximately 78.03 % by volume and 75.47 % by mass in this mixture.

3. Nitrogen and Argon have a major portion in the dry air.
a) False
b) True

Answer: a
Explanation: Dry air is the mixture of a number of gases like nitrogen, oxygen, carbon dioxide, hydrogen, etc. In this mixture, nitrogen has the maximum contribution. Nitrogen is approximately 78.03 % by volume and 75.47 % by mass in this mixture. Oxygen is approximately 20.99 % by volume and 23.19 % by mass in the mixture. But the argon has a very little portion in the mixture. So, Nitrogen and Oxygen have a major portion in the dry air.

4. Mixture of dry air and water vapor is ___________
a) moist air
b) dry air
c) fresh air
d) saturated air

Answer: a
Explanation: If water vapor is present in a larger amount in the dry air, then the type of air is called as moist air. The amount of water vapor present in the air depends upon the absolute pressure and temperature of the mixture.

5. Specific humidity and absolute humidity have the same unit.
a) False
b) True

Answer: a
Explanation: Humidity ratio or Specific humidity is the mass of water vapor present in 1 kg of dry air. It is generally expressed in, g / kg of dry air and absolute humidity is the mass of water present in 1 m^3 of dry air. It is generally expressed in, g / m^3 of dry air.

6. The mixture of dry air and water vapor called when the air has diffused the maximum amount of water vapor into it is called ________
a) dry air
b) moist air
c) saturated air
d) specific humidity

Answer: c
Explanation: Saturated air is the mixture of dry air and water vapor when the air has diffused the maximum amount of water vapor into it. The water vapors occur in the form of superheated steam as an invisible gas.

7. What is the ratio of actual mass of water vapor in a unit mass of dry air to the mass of water vapor in the same mass of dry air when it is saturated at the same temperature?
a) Moist air
b) Dry air

c) Degree of saturation
d) Saturated air

Answer: c
Explanation: The ratio of actual mass of water vapor in a unit mass of dry air to the mass of water vapor in the same mass of dry air when it is saturated at the same temperature is called as the degree of saturation.

8. What is the mass of water vapor present in 1 kg of dry air called?
a) Specific Humidity
b) Relative humidity
c) Degree of saturation
d) Saturated air

Answer: a
Explanation: Humidity ratio or Specific humidity is the mass of water vapor present in 1 kg of dry air. It is generally expressed in, g / kg of dry air. Mathematically, $W = m_v / m_a$.

9. What is the ratio of actual mass of water vapor in a given volume of moist air to the mass of water vapor in the same volume of saturated air at the same pressure and temperature?
a) Specific Humidity
b) Relative humidity
c) Degree of saturation
d) Saturated air

Answer: b
Explanation: Relative humidity is the ratio of actual mass of water vapor in a given volume of moist air to the mass of water vapor in the same volume of saturated air. It can be represented as,
âˆ… $= m_v / m_s = p_v / p_s$.

10. What is the temperature of air recorded by a thermometer, when the moisture present in it starts condensing?
a) DBT
b) WBT
c) DPT
d) WBD

Answer: c
Explanation: DPT i.e., Dew Point Temperature is the temperature at which the moisture in it begins to condense. It can also be defined as the temperature corresponding to the partial pressure of water vapor.

11. What is the mixture of dry air and water vapor called when the air has diffused the maximum amount of water vapor into it?
a) Dry air
b) Moist air
c) Saturated air
d) Specific humidity

Answer: c
Explanation: Saturated air is the mixture of dry air and water vapor when the air has diffused the maximum amount of water vapor into it. The water vapors occur in the form of superheated steam as an invisible gas.

12. What is the temperature of air recorded by thermometer when it is not affected by the moisture present in it?
a) WBT
b) DBT
c) DPT
d) Sub-zero Temperature

Answer: b
Explanation: DBT means Dry Bulb Temperature is the temperature of the air recorded by thermometer and is not affected by moisture in it.

13. For unsaturated air, the value of DPT is __________ WBT.
a) less than
b) more than
c) equal to
d) much more than

Answer: a
Explanation: Moist air containing moisture in the superheated state then the air is called unsaturated air. In such a situation, the dew point temperature is less than the wet-bulb temperature.

14. What is the difference between DBT and WBT called?
a) DPD
b) DBD
c) Degree of saturation
d) WBD

Answer: d
Explanation: The difference between dry bulb temperature and wet bulb temperature is called wet-bulb depression. It indicates the relative humidity of the air.

15. If wet-bulb depression is zero, then the relative humidity is also zero.
a) False
b) True

Answer: a
Explanation: The difference between dry bulb temperature and wet bulb temperature is called wet-bulb depression. It indicates the relative humidity of the air. So, if the wet-bulb depression is zero, then the relative humidity is 100 % or 1.0.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometric Chartâ€�.

1. What do vertical and uniformly spaced lines indicate on the psychrometric chart?
a) DPT
b) WBT
c) DBT
d) Specific humidity

Answer: c
Explanation: The psychrometric chart has DBT on the x-axis. So, the vertical and uniformly spaced lines denote dry bulb temperature and spaced by 5Â°C.

2. Which of the following is represented by curved lines on the psychrometric chart?
a) Specific humidity
b) Relative humidity
c) WBT
d) DPT

Answer: b
Explanation: The psychrometric chart has DBT on the x-axis and specific humidity on the y-axis. The curved line on the grid shows the relative humidity. From 0 to 100 %, these lines are drawn at an interval of 10%.

3. What is represented by inclined straight lines but non-uniformly spaced on the psychrometric chart?
a) Specific humidity
b) Relative humidity
c) WBT
d) DPT

Answer: c
Explanation: The psychrometric chart has DBT on the x-axis and specific humidity on the y-axis. The inclined lines from the saturation curve and on the x-axis denote wet-bulb temperature.

4. What is represented by horizontal lines but non-uniformly spaced on the psychrometric chart?
a) Specific humidity
b) Relative humidity
c) WBT
d) DPT

Answer: d
Explanation: The psychrometric chart has DBT on the x-axis and specific humidity on the y-axis. The horizontal lines from the saturation curve and parallel to the abscissa denote dew point temperature.

5. What is represented by inclined straight lines but uniformly spaced on the psychrometric chart?
a) Enthalpy

b) Relative humidity
c) WBT
d) DPT

Answer: a
Explanation: The psychrometric chart has DBT on the x-axis and specific humidity on the y-axis. The inclined lines from the saturation curve and parallel to the wet-bulb temperature lines denote Enthalpy.

6. What is represented by obliquely inclined straight lines but uniformly spaced on the psychrometric chart?
a) Enthalpy
b) Relative humidity
c) Specific volume
d) DPT

Answer: c
Explanation: The psychrometric chart has DBT on the x-axis and specific humidity on the y-axis. The obliquely inclined lines from the saturation curve and on the dry-bulb temperature lines denote Specific volume.

7. Specific humidity lines are also known as_________
a) moisture content lines
b) relative humidity
c) specific volume
d) moist lines

Answer: a
Explanation: Specific humidity is the moisture present in the air mixture. So, specific humidity denotes moisture content. Hence, these lines are also known as moisture content lines.

8. Relative humidity on saturation curve has value of ________% at various dry bulb temperatures.
a) 0
b) 50
c) 10
d) 100

Answer: d
Explanation: Relative humidity is the ratio of actual mass of water vapor in the given volume of moist air to the mass of water vapor in the same amount of saturated air. So, on the saturation curve, for every dry bulb temperature, the value of relative humidity remains 100%.

9. Enthalpy lines and specific volume lines are the same.
a) False
b) True

Answer: a
Explanation: Though both of the lines representing given properties are inclined straight lines and uniformly spaced, but the slope of both the lines are different. The specific volume lines are obliquely inclined.

10. A psychrometric chart is a graphical representation of various physical properties of dry air.
a) True
b) False

Answer: b
Explanation: Psychrometric chart is a graphical representation of the various thermodynamic properties of moist air. This is used to find out properties of air in the field of air conditioning.

11. Which of the following represents sensible cooling on the psychrometric chart?
a) Horizontal line
b) Vertical line
c) Inclined line
d) Curve

Answer: a
Explanation: Sensible cooling is when DBT decreases. And as per the psychrometric chart, horizontal lines show the change in just DBT and represent sensible cooling.

12. Which of the following represents sensible heating on the psychrometric chart?
a) Horizontal line
b) Vertical line

c) Inclined line
d) Curve

Answer: a
Explanation: Sensible cooling is when DBT rises. And as per the psychrometric chart, horizontal lines show the change in just DBT and represent sensible heating. It is in the opposite direction of sensible cooling.

13. What is the range of DBT on the psychrometric chart usually used?
a) 0 to 30Â°C
b) 0 to 45Â°C
c) -6 to 45Â°C
d) -2 to 45Â°C

Answer: c
Explanation: Generally, the temperature range of dry bulb temperature lines on the psychrometric chart is from -6 to 45Â°C. These lines are drawn with a difference of every 5Â°C of DBT.

14. Which of the following is not correct to fill the blank: The psychrometric chart is normally drawn for standard atmospheric pressure of ________
a) 760 mm of Hg
b) 76 cm of Hg
c) 1.01325 bar
d) 1.01325 torr

Answer: d
Explanation: The psychrometric chart is drawn on the standard values. The standard atmospheric pressure has a value 1.01325 bar. If we convert into other units, then 760 mm of Hg and 76 cm of Hg are also appropriate values of standard pressure, but 1.01325 torr is not. So, this cannot be filled in the blank space.

15. On the Psychrometric chart, the coordinates of any point on it will have abscissa as specific humidity value and ordinate as a dry bulb temperature value.
a) False
b) True

Answer: a
Explanation: The psychrometric chart has DBT and Sp. Humidity on the x-axis and y-axis, respectively. So, any point on the chart will have specific humidity as ordinate and dry bulb temperature as abscissa.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometry â€“ Thermodynamic Wet Bulb Temperatureâ€�.

1. What is the alternate name for thermodynamic wet-bulb temperature?
a) Isobaric WBT
b) Isobaric Saturation Temperature
c) Adiabatic WBT
d) Adiabatic Saturation Temperature

Answer: d
Explanation: The thermodynamic wet-bulb temperature is also known as adiabatic saturation temperature due to the process involved in it.

2. What is the temperature at which air can be brought to saturation state adiabatically?
a) Thermodynamic WBT
b) Thermodynamic DBT
c) Thermodynamic DPT
d) DPT

Answer: a
Explanation: The temperature at which air can be brought to saturation state adiabatically is called a thermodynamic wet-bulb temperature or adiabatic saturation temperature.

3. Which of the following is carried out to obtain saturation state at the thermodynamic WBT?
a) Condensation
b) Evaporation
c) Compression
d) Expansion

Answer: b
Explanation: The temperature at which air can be brought to saturation state adiabatically is called a thermodynamic wet-bulb temperature or adiabatic saturation temperature. This state is achieved by evaporation of water into the flowing air.

4. Which of the following is the major equipment in the simplest form is used to do saturation of air?
a) Chamber
b) Vessel
c) Insulated Chamber
d) Pipe

Answer: c
Explanation: The equipment used for saturation of the air in the simplest form is an insulated chamber containing an optimum amount of water.

5. The arrangement for extra-water to flow into the chamber from its top is called as ____________
a) chamber ingot
b) chamber gate
c) make-up gate
d) make-up water

Answer: d
Explanation: The equipment used for saturation of the air in the simplest form is an insulated chamber containing an optimum amount of water. In order to get more water into the chamber, an arrangement is provided, which is called make-up water.

6. What is the ratio of humidity ratio of entering and discharging air?
a) $W_2 / W_1 = (h_{s2}$ â€“ $h_{fw}) + h_{a2}$ â€“ $h_{a1} / (h_{s1}$ â€“ $h_{fw})$
b) $W_1 / W_2 = (h_{s1}$ â€“ $h_{fw}) + h_{a2}$ â€“ $h_{a1} / (h_{s2}$ â€“ $h_{fw})$
c) $W_1 / W_2 = (h_{s2}$ â€“ $h_{fw}) + h_{a2}$ â€“ $h_{a1} / (h_{s1}$ â€“ $h_{fw})$
d) $W_1 / W_2 = (h_{s2}$ â€“ $h_{fw}) + h_{a1}$ â€“ $h_{a2} / (h_{s1}$ â€“ $h_{fw})$

Answer: c
Explanation: Balancing enthalpies, h_1 â€“ $W_1 h_{fw} = h_2$ â€“ $W_2 h_{fw}$
As, $h_1 = h_{a1} + W_1 h_{s1}$ and $h_2 = h_{a2} + W_2 h_{s2}$
So, by putting values we get,
$W_1 / W_2 = (h_{s2}$ â€“ $h_{fw}) + h_{a2}$ â€“ $h_{a1} / (h_{s1}$ â€“ $h_{fw})$.

7. The term (h_2 â€“ $W_2 h_{fw}$) is known as__________
a) sigma term
b) sigma heat
c) heat factor
d) heat term

Answer: b
Explanation: The term (h_2 â€“ $W_2 h_{fw}$) is known as sigma heat, and this term remains constant during the adiabatic process.

8. If h_1 = 32 kJ/kg, h_2 = 41 kJ/kg, h_{fw} = 49 kJ/kg, W_1 = 0.0109 kg/kg of dry air and W_2 = 0.0297 kg/kg of dry air then what is the value of sigma heat?
a) 41.0865
b) 39.5447
c) 38.9013
d) 45.8775

Answer: b
Explanation: Sigma heat = (h_2 â€“ $W_2 h_{fw}$)
So, putting values in the formula,
Sigma heat = [41 â€“ (49 x 0.0297)] = 39.5447.

9. Evaporation from water to flowing air is carried out adiabatically.
a) False
b) True

Answer: b
Explanation: The temperature at which air can be brought to saturation state adiabatically is called a thermodynamic wet-bulb temperature or adiabatic saturation temperature. This state is achieved by evaporation of water into the flowing air.

10. Make-up water is used to keep the water level constant.
a) True
b) False

Answer: a
Explanation: In order to get more water into the chamber, an arrangement is provided, which is called make-up water. This water is added from the top to keep the water level constant and keep the energy transfer at an optimum pace.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometric Relationsâ€�.

1. What is the value of humidity ratio if $p_v = 0.387$ bar and $p_a = 0.997$ bar?
a) 0.482
b) 0.241
c) 0.122
d) 0.622

Answer: b
Explanation: Humidity ratio is the mass of water vapor present in 1 kg of dry air and has a unit g / kg of dry air.
$W = 0.622\ p_v / p_a$
$= 0.622 \times 0.387 / 0.997$
$= 0.241$ kg / kg of dry air.

2. What is the value of humidity ratio if $m_v = 1.423$ and $m_a = 3.589$?
a) 0.1
b) 0.2
c) 0.4
d) 0.5

Answer: c
Explanation: Humidity ratio is the mass of water vapor present in 1 kg of dry air and has a unit g / kg of dry air. It is also defined as the ratio of the mass of water vapor to the mass of dry air in a given volume of the air-vapor mixture. Hence, it is given as m_v / m_a.
W = 1.423 / 3.589 = 0.396 â‰… 0.4.

3. What is the value of relative humidity if $m_v = 2.901$ and $m_s = 9.056$?
a) 0.300
b) 0.330
c) 0.310
d) 0.320

Answer: d
Explanation: Relative humidity is the ratio of actual mass of water vapor in a given volume of moist air to the mass of water vapor in the same volume of saturated air. It can be represented as,
âˆ… $= m_v / m_s = p_v / p_s = 2.901 / 9.056 = 0.320$.

4. What is the value of relative humidity if $p_v = 0.468$ bar and $p_s = 0.893$ bar?
a) 52 %
b) 54 %
c) 56 %
d) 190 %

Answer: a
Explanation: Relative humidity is the ratio of actual mass of water vapor in a given volume of moist air to the mass of water vapor in the same volume of saturated air. It can be represented as,
âˆ… $= m_v / m_s = p_v / p_s = 0.468 / 0.893 = 0.524 = 52.4$ %.

5. What is the value of p_b if $p_a = 1.48$ bar and $p_v = 1.52$ bar, according to Daltonâ€™s law of partial pressures?
a) 1 bar

b) 2 bar
c) 3 bar
d) 4 bar

Answer: c
Explanation: The Daltonâ€™s law states that the total pressure exerted by the mixture of air and water vapor is equal to the sum of the pressures, which each constituent would exert if it occupied the same space by itself. Mathematically, it can be represented as, $p_b = p_a + p_v = 1.48 + 1.52 = 3$ bar.

6. If DBT = 30Â°C, WBT = 20Â°C and Barometer reading is 740 mm of Hg. Find out DPT using steam tables.
a) 5Â°C
b) 35Â°C
c) 15Â°C
d) 25Â°C

Answer: b
Explanation: For given conditions, pressure corresponding to WBT from steam table is p_w = 0.02337 bar
p_b = 740 mm of Hg = 740 x 133.3 / 100000 = 0.98642 bar
Pressure of water vapor = p_v = p_w â€“ [(p_b â€“ p_w) (t_d â€“ t_w) / 1544 â€“ 1.44 t_w]
= 0.02337 â€“ [(0.98642 â€“ 0.02337) (30 â€“ 20) / 1544 â€“ 1.44 x 20]
= 0.01701 bar
For 0.01701 bar water vapor pressure, dew point temperature is 15Â°C.

7. If DBT = 30Â°C, WBT = 20Â°C and Barometer reading is 740 mm of Hg. Find out relative humidity using steam tables.
a) 40 %
b) 50 %
c) 30 %
d) 20 %

Answer: a
Explanation: For given conditions, pressure corresponding to WBT from steam table is p_w = 0.02337 bar
p_b = 740 mm of Hg = 740 x 133.3 / 100000 = 0.98642 bar
Pressure of water vapor = p_v = p_w â€“ [(p_b â€“ p_w) (t_d â€“ t_w) / 1544 â€“ 1.44 t_w]
= 0.02337 â€“ [(0.98642 â€“ 0.02337) (30 â€“ 20) / 1544 â€“ 1.44 x 20]
= 0.01701 bar
Saturation pressure for given DBT is p_s = 0.04242 bar
Relative humidity = p_v / p_s = 0.01701 / 0.04242 = 0.40 = 40 %.

8. If DBT = 30Â°C, WBT = 20Â°C and Barometer reading is 740 mm of Hg. Find out specific humidity using steam tables.
a) 10.914 m_3 / kg of dry air
b) 10.914
c) 10.914 kg / kg of dry air
d) 10.914 g / kg of dry air

Answer: d
Explanation: For given conditions, pressure corresponding to WBT from steam table is p_w = 0.02337 bar
p_b = 740 mm of Hg = 740 x 133.3 / 100000 = 0.98642 bar
Pressure of water vapor = p_v = p_w â€“ [(p_b â€“ p_w) (t_d â€“ t_w) / 1544 â€“ 1.44 t_w]
= 0.02337 â€“ [(0.98642 â€“ 0.02337) (30 â€“ 20) / 1544 â€“ 1.44 x 20]
= 0.01701 bar
Specific humidity = W = 0.622 p_v / p_b â€“ p_v = 0.622 x 0.01701 / 0.98642 â€“ 0.01701 = 10.914 g / kg of dry air.

9. If DBT = 30Â°C, WBT = 20Â°C and Barometer reading is 740 mm of Hg. Find out degree of saturation using steam tables.
a) 40 %
b) 39 %
c) 38 %
d) 35 %

Answer: b
Explanation: For given conditions, pressure corresponding to WBT from steam table is $p_w = 0.02337$ bar
$p_b = 740$ mm of Hg = 740 x 133.3 / 100000 = 0.98642 bar
Pressure of water vapor = $p_v = p_w$ â€“ [(p_b â€“ p_w) (t_d â€“ t_w) / 1544 â€“ 1.44 t_w]
= 0.02337 â€“ [(0.98642 â€“ 0.02337) (30 â€“ 20) / 1544 â€“ 1.44 x 20]
= 0.01701 bar
Specific humidity = W = 0.622 p_v / p_b â€“ p_v = 0.622 x 0.01701 / 0.98642 â€“ 0.01701 = 10.914 g / kg of dry air
Saturation pressure for given DBT is $p_s = 0.04242$ bar
$W_s = 0.622$ p_s / p_b â€“ p_s = 0.622 x 0.004242 / 0.98642 â€“ 0.04242 = 27.945 g / kg of dry air
Degree of saturation, Î¼ = W / W_s = 10.914 / 27.945 = 0.39 = 39 %.

10. If DBT = 30Â°C, WBT = 20Â°C and Barometer reading is 740 mm of Hg. Find out vapor density using steam tables.
a) 0.01216 kg / m^3 of dry air
b) 0.01216 g / m^3 of dry air
c) 0.01216 m^3 / m^3 of dry air
d) 0.01216 kg / kg of dry air

Answer: a
Explanation: For given conditions, pressure corresponding to WBT from steam table is $p_w = 0.02337$ bar
$p_b = 740$ mm of Hg = 740 x 133.3 / 100000 = 0.98642 bar
Pressure of water vapor = $p_v = p_w$ â€“ [(p_b â€“ p_w) (t_d â€“ t_w) / 1544 â€“ 1.44 t_w]
= 0.02337 â€“ [(0.98642 â€“ 0.02337) (30 â€“ 20) / 1544 â€“ 1.44 x 20]
= 0.01701 bar
Specific humidity = W = 0.622 p_v / p_b â€“ p_v = 0.622 x 0.01701 / 0.98642 â€“ 0.01701 = 10.914 g / kg of dry air
Ï� $_v$ = W (p_b â€“ p_v) / R_a T_d = 0.010914 (0.98642 â€“ 0.01701) 105 / 287 (273 + 30)
= 0.01216 kg / m^3 of dry air.

11. What is the humidity ratio in terms of mass?
a) m_v / m_a
b) m_a / m_v
c) p_v / p_a
d) p_a / p_v

Answer: a
Explanation: Humidity ratio is the mass of water vapor present in 1 kg of dry air and has a unit g / kg of dry air. It is also defined as the ratio of the mass of water vapor to the mass of dry air in a given volume of the air-vapor mixture. Hence, it is given as m_v / m_a.

12. What is the humidity ratio in terms of pressure?
a) 0.622 p_v / p_b
b) 0.622 p_v / p_a
c) 0.622 m_v / m_b
d) 0.622 m_v / m_a

Answer: b
Explanation: Humidity ratio is the mass of water vapor present in 1 kg of dry air and has a unit g / kg of dry air. It is also defined as the ratio of the mass of water vapor to the mass of dry air in a given volume of the air-vapor mixture. Hence, it is given as m_v / m_a = R_a p_v / R_v p_a using ideal gas equation.
$R_a = 0.287$ and $R_v = 0.461$ kJ/kg K, putting these values in above equation we get,
W = 0.287 / 0.461 (p_v / p_a)
W = 0.622 p_v / p_a.

13. Relative humidity is represented as __________
a) m_v / m_a

b) m_a / m_v
c) p_s / p_v
d) m_v / m_s

Answer: d
Explanation: Relative humidity is the ratio of actual mass of water vapor in a given volume of moist air to the mass of water vapor in the same volume of saturated air. It can be represented as,
âˆ… = $m_v / m_s = p_v / p_s$.

14. Which of the following is true, according to Daltonâ€™s law of partial pressures?
a) $p_b = p_a \times p_v$
b) $p_b = p_a$ â€“ p_v
c) $p_b = p_a + p_v$
d) $p_a = p_b + p_v$

Answer: c
Explanation: The Daltonâ€™s law states that the total pressure exerted by the mixture of air and water vapor is equal to the sum of the pressures, which each constituent would exert if it occupied the same space by itself. Mathematically, it can be represented as, $p_b = p_a + p_v$.

15. If the relative humidity is zero, then the humidity ratio is infinity.
a) False
b) True

Answer: a
Explanation: Relative humidity is the ratio of actual mass of water vapor in a given volume of moist air to the mass of water vapor in the same volume of saturated air. It can be represented as,
If, âˆ… = $m_v / m_s = p_v / p_s = 0$,
Then W = 0. So, the humidity ratio is zero if the relative is zero.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometry â€“ By-Pass Factorâ€�.

1. What is the inefficiency of the coil to attain the desired temperature called?
a) By-pass factor
b) Effectiveness
c) Efficiency
d) By-pressure factor

Answer: a
Explanation: The DBT of air leaving the apparatus should be equal to the coil temperature, but this is not possible due to the inefficiency of the coil. This type of phenomenon is called a by-pass factor.

2. What is the number of fins provided in a unit length called?
a) By-pass
b) Distance
c) Pitch
d) Addendum

Answer: c
Explanation: By-pass factor depends upon the number of fins provided. So, the fins provided in a unit length are called as Pitch of the coil fins.

3. Which of the following is true about the effect of velocity on the by-pass factor?
a) decreases with an increase in velocity of air passing through it
b) remains unchanged with an increase in velocity of air passing through it
c) may increase or decrease with an increase in velocity of air passing through it depending upon the condition of air entering
d) increases with an increase in velocity of air passing through it

Answer: d
Explanation: The change in the velocity affects the temperature of leaving the air. Moreover, the inefficiency increases due to an increase in velocity as the by-pass factor increases.

4. The by-pass factor of the coil ___________ with _________ in fin spacing.
a) increases, increase
b) decreases, decrease
c) increases, decrease
d) decreases, increase

Answer: b
Explanation: One of the factors which affect the by-pass factor is fin spacing. If the fin spacing is not much, then the temperature leaving the apparatus becomes close to the coil temperature. So, the decrease in fin spacing results in a decrease in the by-pass factor by improving efficiency.

5. The by-pass factor of the coil ___________ with _________ in number of rows of fins.
a) increases, increase
b) decreases, decrease
c) increases, decrease
d) decreases, increase

Answer: d
Explanation: One of the factors which affect the by-pass factor is a number of rows of fins. More the number of rows of fins, better is the heat transfer rate and decreasing the inefficiency, i.e., by-pass factor. So, the increase in the number of rows results in a decrease in the by-pass factor by improving efficiency.

6. Which of the following does not affect the by-pass factor?
a) Pitch of the coil fins
b) Velocity of air
c) Weight of apparatus
d) Fin spacing

Answer: c
Explanation: The weight of the apparatus has nothing to do with the by-pass factor. Pitch of the coil does affect the by-pass factor. And the velocity of air as well as fin spacing affects the by-pass factor. These factors can reduce the efficiency of the process.

7. Number of rows of the fins in the opposite direction to the flow affects BPF.
a) False
b) True

Answer: a
Explanation: More the number of rows increases the heat transfer rate and decrease the by-pass factor. But these rows should be in the direction of flow to get desired results.

8. Air being passed by not being in contact with the coil known to be measured as BPF.
a) True
b) False

Answer: a
Explanation: When air flows, some of it gets in contact with the coil, and some passes directly unaffected. This by-pass process is measured as a by-pass factor and is affected by a lot of parameters.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometry â€“ Heating and Cooling Factor â€“ 1â€�.

1. What is the By-pass factor for heating coil, if td_1 = temperature at entry, td_2 = temperature at exit and td_3 = coil temperature?
a) td_3 â€“ td_1 / td_3 â€“ td_1
b) td_3 â€“ td_2 / td_3 â€“ td_1
c) td_3 â€“ td_2 / td_2 â€“ td_1
d) td_3 â€“ td_2 / td_1 â€“ td_2

Answer: b
Explanation: By-pass factor is the amount of air by-passed in the process. So, for heating coil,
BPF = Temperature difference between coil and exit / Temperature difference between coil and entry
= td_3 â€“ td_2 / td_3 â€“ td_1 .

2. What is the By-pass factor for cooling coil, if td_1 = temperature at entry, td_2 = temperature at exit and td_3 = coil temperature?
a) td_3 â€“ td_1 / td_3 â€“ td_1
b) td_3 â€“ td_2 / td_3 â€“ td_1
c) td_3 â€“ td_2 / td_2 â€“ td_1
d) td_2 â€“ td_3 / td_1 â€“ td_3

Answer: d
Explanation: By-pass factor is the amount of air by-passed in the process. So, for cooling coil,
BPF = Temperature difference between exit and coil / Temperature difference between entry and coil
= td_2 â€“ td_3 / td_1 â€“ td_3 .

3. If the value of BPF for one row of a coil is y then what is the value of BPF for n similar rows?
a) n / y
b) n + y
c) $(y)^n$
d) n x y

Answer: c
Explanation: BPF for multiple similar rows of a coil is the power of one BPF to the number of rows. i.e. $(y)^n$.

4. What is the value of sensible heat given out by the coil?
a) $U A_c t_m$
b) $U A_c$
c) $U t_m$
d) $U A_c^2 t_m$

Answer: a
Explanation: Sensible heat given out by the coil is the product of overall heat transfer coefficient, the surface area of the coil and logarithmic mean temperature difference.
So, Sensible heat = $U A_c t_m$.

5. What is the formula of logarithmic mean temperature in terms of By-pass factor?
a) $T_m = td_2$ â€“ $td_1 / \log_e$ [1/BPF]
b) $T_m = td_2$ â€“ $td_1 / \log_{10}$ [BPF]
c) $T_m = td_2$ â€“ $td_1 / \log_e$ [BPF]
d) $T_m = td_2$ â€“ $td_3 / \log_e$ [BPF]

Answer: c
Explanation: Logarithmic mean temperature difference for the given arrangement is,
$T_m = td_2$ â€“ $td_1 / \log_e$ [td_3 â€“ td_1 / td_3 â€“ td_2]
As, BPF for the coil = [td_3 â€“ td_1 / td_3 â€“ td_2]
$T_m = td_2$ â€“ $td_1 / \log_e$ [BPF].

6. What is the efficiency of the coil?
a) 1 + BPF
b) 1 / BPF
c) BPF
d) 1 â€“ BPF

Answer: d
Explanation: As the by-pass factor is the inefficiency, so the contact factor or efficiency of the coil is given by 1 â€“ BPF.

7. What is the contact factor for heating coil, if td_1 = temperature at entry, t_2 = temperature at exit and td_3 = coil temperature?
a) td_3 â€“ td_1 / td_3 â€“ td_1
b) td_2 â€“ td_1 / td_3 â€“ td_1

c) td_3 â€“ td_2 / td_2 â€“ td_1
d) td_3 â€“ td_2 / td_1 â€“ td_2

Answer: b
Explanation: Contact factor or efficiency of the coil is 1 â€“ By-pass factor. So, for heating coil,
Î· $_H$ = 1 â€“ BPF
= 1 â€“ [td_3 â€“ td_2 / td_3 â€“ td_1]
= td_2 â€“ td_1 / td_3 â€“ td_1 .

8. What is the contact factor for cooling coil, if td_1 = temperature at entry, td_2 = temperature at exit and td_3 = coil temperature?
a) td_1 â€“ td_2 / td_1 â€“ td_3
b) td_2 â€“ td_1 / td_3 â€“ td_1
c) td_3 â€“ td_2 / td_2 â€“ td_1
d) td_3 â€“ td_2 / td_1 â€“ td_2

Answer: a
Explanation: Contact factor or efficiency of the coil is 1 â€“ By-pass factor. So, for cooling coil,
Î· $_C$ = 1 â€“ BPF
= 1 â€“ [td_2 â€“ td_3 / td_1 â€“ td_3]
= td_1 â€“ td_2 / td_1 â€“ td_3 .

9. A coil with low BPF has better performance.
a) True
b) False

Answer: a
Explanation: As BPF is the amount of air bypassed in the process and is the inefficiency of the coil. So, lower the value of BPF then better is the performance and vice-versa.

10. The value of BPF for the heating and the cooling coil is different under the same temperature conditions.
a) True
b) False

Answer: b
Explanation: BPF for heating coil is, BPF = td_3 â€“ td_2 / td_3 â€“ td_1
BPF for cooling coil is, BPF = td_2 â€“ td_3 / td_1 â€“ td_3
As the numerator and denominator are reversed in the cooling coil than the heating coil. So, the value we get for either of the coils is the same.

This set of Air-Conditioning online test focuses on â€œPsychrometry â€“ Heating and Cooling Factor â€“ 2â€�.

1. What is the By-pass factor for heating coil, if td_1 = 19Â°C, td_2 = 25Â°C and td_3 = 37Â°C?
a) 0.75
b) 0.4
c) 0.7
d) 0.1

Answer: c
Explanation: By-pass factor is the amount of air by-passed in the process. So, for heating coil,
BPF = Temperature difference between coil and exit / Temperature difference between coil and entry
= td_3 â€“ td_2 / td_3 â€“ td_1
= 37 â€“ 25 / 37 â€“ 19
= 0.70588 = 0.7.

2. What is the By-pass factor for cooling coil, if td_1 = 49Â°C, td_2 = 36Â°C and td_3 = 30Â°C?
a) 0.315
b) 0.31
c) 0.320
d) 0.3

Answer: a
Explanation: By-pass factor is the amount of air by-passed in the process. So, for the cooling coil,
BPF = Temperature difference between exit and coil / Temperature difference between entry and coil
$= td_2$ â€“ td_3 / td_1 â€“ td_3
= 36 â€“ 30 / 49 â€“ 30
= 0.315.

3. If the value of BPF for one row of the coil is one, then what is the value of BPF for 3872 similar rows?
a) 3872
b) 3871
c) 3873
d) 1

Answer: d
Explanation: BPF for multiple similar rows of the coil is the power of one BPF to the number of rows. i.e. $(y)^n$
So, $(1)^{3872} = 1$, for any value of n, the value comes one only.

4. If the value of BPF for one row of the coil is 0.4, then what is the value of BPF for 12 similar rows?
a) 0.00000167
b) 0.0000167
c) 0.00167
d) 0.000167

Answer: b
Explanation: BPF for multiple similar rows of the coil is the power of one BPF to the number of rows. i.e. $(y)^n$
So, $(0.4)^{12} = 0.0000167$.

5. What is the value of sensible heat given out by the coil, if U = 198 W/m^2 K, $A_c = 11$ m^2 and t_m = 0Â°C?
a) 1
b) 0
c) 594594
d) 543636

Answer: b
Explanation: Sensible heat given out by the coil is the product of the overall heat transfer coefficient, the surface area of the coil, and logarithmic mean temperature difference.
So, Sensible heat = $U A_c t_m$ = 198 x 11 x (273 + 0) = 594594.

6. What is the value of BPF, if U = 1.9 W/m^2 K, $A_c = 1.1$ m^2 and $m_a = 0.97$ kg?
a) 0.14
b) 0.12
c) 0.13
d) 0.15

Answer: b
Explanation: BPF = $e^{-[U A_c / 1.022 m_a]} = e^{-[1.9 x 1.1/ 1.022 x 0.97]} = e^{-[2.1082]} = 0.12$.

7. What is the value of logarithmic mean temperature if $td_1 = 300$ K, $td_2 = 400$ K and BPF = 0.75?
a) 70Â°C
b) 79Â°C
c) 85Â°C
d) 75Â°C

Answer: d
Explanation: Logarithmic mean temperature difference for the given arrangement is,
$T_m = td_2$ â€“ $td_1 / \log_e [td_3$ â€“ td_1 / td_3 â€“ $td_2]$
As, BPF for the coil = $[td_3$ â€“ td_1 / td_3 â€“ $td_2]$
$T_m = td_2$ â€“ $td_1 / \log_e$ [BPF]
= 400 â€“ 300 / ln (1/0.75) = 100 / 0.287 = 348.43 K = 75.43Â°C = 75Â°C.

8. What is the efficiency of the coil, if BPF = 0.6913?
a) 1.6913

b) 0.4467
c) 0.3087
d) 1.4467

Answer: c
Explanation: As the by-pass factor is the inefficiency, so the contact factor or efficiency of the coil is given by 1 â€“ BPF = 1 â€“ 0.6913 = 0.3087.

9. What is the contact factor for heating coil, if td_1 = 11Â°C, td_2 = 32Â°C and td_3 = 47Â°C?
a) 0.5833
b) 0.4833
c) 0.7833
d) 0.1833

Answer: a
Explanation: By-pass factor is the amount of air by-passed in the process. So, for heating coil,
BPF = Temperature difference between coil and exit / Temperature difference between coil and entry
= td_3 â€“ td_2 / td_3 â€“ td_1
= 47 â€“ 32 / 47 â€“ 11
= 0.4167
Î·$_H$ = 1 â€“ BPF = 1 â€“ 0.4167 = 0.5833.

10. What is the contact factor for cooling coil, if td_1 = 44Â°C, td_2 = 26Â°C and td_3 = 19Â°C?
a) 0.62
b) 0.72
c) 0.78
d) 0.18

Answer: b
Explanation: By-pass factor is the amount of air by-passed in the process. So, for the cooling coil,
BPF = Temperature difference between coil and exit / Temperature difference between coil and entry
= td_2 â€“ td_3 / td_1 â€“ td_3
= 26 â€“ 19 / 44 â€“ 19
= 0.28
Î·$_C$ = 1 â€“ BPF = 1 â€“ 0.28 = 0.72.

11. For given conditions, td_1 = 288 K, td_2 = 301 K and td_3 = 314 K, the value of by-pass factor and contact factor is equal.
a) True
b) False

Answer: a
Explanation: BPF = 314 â€“ 301 / 314 â€“ 288 = 13 / 26 = 0.5 and Î· = 1 â€“ BPF = 1 â€“ 0.5 = 0.5
So, for given set of values the value of contact factor and by-pass factor is equal.

12. Higher the value of contact factor, poor is the performance of the coil.
a) True
b) False

Answer: b
Explanation: The contact factor is the efficiency of the coil. So, if the value of it is higher, then better is the performance and vice-versa. It is the opposite of BPF.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometry â€“ Humidification and Dehumidificationâ€�.

1. Which of the following denotes Humidification process on the psychrometric chart?
a) A horizontal line with an arrow towards right
b) Vertical line with arrow upwards
c) Horizontal line with an arrow towards right
d) Vertical line with arrow downwards

Answer: b
Explanation: Psychrometric chart has DBT on the x-axis and sp. Humidity on the y-axis. So, if a process is going up

on the chart, then there is an increase in relative as well as specific humidity. So, the vertical line with an arrow upwards denotes humidification process.

2. Which of the following denotes dehumidification process on the psychrometric chart?
a) A horizontal line with an arrow towards the right
b) Vertical line with arrow upwards
c) A horizontal line with an arrow towards the right
d) Vertical line with arrow downwards

Answer: d
Explanation: Psychrometric chart has DBT on the x-axis and sp. Humidity on the y-axis. So, if a process is going down on the chart, then there is a decrease in relative as well as specific humidity. So, the vertical line with an arrow downwards denotes dehumidification process.

3. Which of the following is denoted by $LH = (h_2 \text{ â€“ } h_1) = h_{fg} (W_2 \text{ â€“ } W_1)$?
a) Sensible cooling
b) Sensible heating
c) Humidification
d) Dehumidification

Answer: c
Explanation: Latent heat transfer i.e., $LH = (h_2 \text{ â€“ } h_1) = h_{fg} (W_2 \text{ â€“ } W_1)$ denotes Humidification. As in the humidification process, there is an increase in specific humidity, so $W_2 > W_1$ and also increase in enthalpy, $h_2 > h_1$.

4. Which of the following is denoted by $LH = (h_1 \text{ â€“ } h_2) = h_{fg} (W_1 \text{ â€“ } W_2)$?
a) Sensible cooling
b) Sensible heating
c) Humidification
d) Dehumidification

Answer: d
Explanation: Latent heat transfer i.e., $LH = (h_1 \text{ â€“ } h_2) = h_{fg} (W_1 \text{ â€“ } W_2)$ denotes dehumidification. As in the dehumidification process, there is a decrease in specific humidity, so $W_1 > W_2$ and also decrease in enthalpy, $h_1 > h_2$.

5. What is the relation between DBT and WBT if the relative humidity is 100%?
a) DBT = WBT
b) DBT > WBT
c) DBT â‰« WBT
d) DBT < WBT

Answer: a
Explanation: When the dry bulb temperature is equal to the wet-bulb temperature, then the relative humidity tends to be 100%.

6. The minimum temperature to which moist air can be cooled under ideal conditions in a spray washer is ____________
a) DPT of inlet air
b) Water inlet temperature
c) WBT of inlet air
d) Water outlet temperature

Answer: c
Explanation: Wet-bulb temperature is the minimum temperature to which moist air can be cooled under ideal conditions in a spray washer. It is an integral part of the process.

7. Which of the following process is used in winter air conditioning?
a) Humidification
b) Dehumidification
c) Heating and Humidification
d) Cooling and Dehumidification

Answer: c
Explanation: In Winter, the weather is dry and cold, so the process of heating and humidification is done to get the desired comfort conditions.

8. Which of the following process is used in summer air conditioning?
a) Humidification
b) Dehumidification
c) Heating and Humidification
d) Cooling and Dehumidification

Answer: d
Explanation: In Summer, the weather is humid and hot, so the process cooling and dehumidification is done to get the desired comfort conditions.

9. What is the value of Latent heat transfer in the process of humidification having enthalpies as 20 and 40 kJ / kg of dry air respectively?
a) 60
b) 40
c) -20
d) 20

Answer: d
Explanation: Latent heat transfer i.e., LH = (h_2 â€“ h_1) = h_{fg} (W_2 â€“ W_1) denotes Humidification. As in the humidification process, there is an increase in specific humidity, so W2 > W1 and also increase in enthalpy, $h_2 > h_1$. So, as per given data, h_1 = 40 and h_2 = 20 kJ / kg of dry air.
So, latent heat transfer = h_2 â€“ h_1 = 40 â€“ 20 = 20 kJ/ kg of dry air.

10. What is the value of Latent heat transfer in the process of dehumidification having enthalpies as 19.45 and 13.67 kJ/ kg of dry air respectively?
a) 5.78
b) -5.78
c) 33.12
d) -33.12

Answer: a
Explanation: Latent heat transfer i.e., LH = (h_1 â€“ h_2) = h_{fg} (W_1 â€“ W_2) denotes dehumidification. As in the dehumidification process, there is a decrease in specific humidity, so $W_1 > W_2$ and also decrease in enthalpy, $h_1 > h_2$. So, as per given data, h_1 = 19.45 and h_2 = 13.67 kJ / kg of dry air.
So, latent heat transfer = h_1 â€“ h_2 = 19.45 â€“ 13.67 = 20 kJ / kg of dry air.

11. What is the value of Latent heat transfer in a process of humidification having h_{fg} = 10 kJ / kg of dry air, W_1 = 0.0071 kJ / kg of dry air and W_2 = 0.0017 kJ / kg of dry air?
a) 0.054
b) 0.0054
c) 0.54
d) 5.4

Answer: a
Explanation: Latent heat transfer i.e., LH = (h_2 â€“ h_1) = h_{fg} (W_2 â€“ W_1) denotes Humidification. As, in the humidification process there is an increase in specific humidity so $W_2 > W_1$ and also increase in enthalpy, $h_2 > h_1$.
So, latent heat transfer = h_{fg} (W_2 â€“ W_1) = 10 (0.0071 â€“ 0.0017) = 0.054 kJ / kg of dry air.

12. During humidification process the dry bulb temperature ____________
a) increases
b) decreases
c) tends to zero
d) remains the same

Answer: d
Explanation: During the humidification process, DBT remains the same as the increase is in specific humidity and relative humidity. As the process is vertical on chart keeping DBT constant.

13. Which of the following is not an indirect method of air-washer humidification?
a) Using vaporization after cooling
b) Using heated spray water
c) Using re-circulated spray water without prior heating of air
d) By pre-heating the air and then washing it with re-circulated air

Answer: a
Explanation: There are direct and indirect methods of obtaining humidification and dehumidification. There are three types of Indirect methods which are as follows:
i.Using heated spray water
ii.Using re-circulated spray water without prior heating of air
iii.By pre-heating the air and then washing it with re-circulated air.

14. During the sensible cooling process, specific humidity decreases.
a) True
b) False

Answer: b
Explanation: Sensible cooling process is the one where dry bulb temperature decreases. It is a horizontal process on the psychrometric chart. Hence, the specific humidity neither increases nor decreases, but there might be some change in relative humidity.

15. In order to cool and dehumidify a stream of moist air, it must be passed over the coil at a temperature between DBT and WBT.
a) True
b) False

Answer: b
Explanation: In order to cool and dehumidify a stream of moist air, it must be passed over the coil at a temperature which is lower than the dew point temperature of the incoming stream to get desire state of the air.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometry â€“ Adiabatic Mixing of Two Streamsâ€�.

1. What is the formula for m_1 / m_2 in terms of enthalpies for adiabatic mixing of two streams?
a) h_1 â€“ h_2 / h_1 â€“ h_3
b) h_3 â€“ h_2 / h_1 â€“ h_3
c) h_3 â€“ h_2 / h_2 â€“ h_3
d) h_3 â€“ h_2 / h_1 â€“ h_2

Answer: b
Explanation: For energy balance, $m_1 h_1 + m_2 h_2 = m_3 h_3$
$m_3 = m_1 + m_2$
So, $m_1 h_1 + m_2 h_2 = (m_1 + m_2) h_3$
By solving we get,
m_1 / m_2 = h_3 â€“ h_2 / h_1 â€“ h_3 .

2. What is the formula for m_1 / m_2 in terms of specific humidity for adiabatic mixing of two streams?
a) W_2 â€“ W_1 / W_1 â€“ W_3
b) W_3 â€“ W_1 / W_1 â€“ W_3
c) W_3 â€“ W_2 / W_1 â€“ W_3
d) W_3 â€“ W_2 / W_2 â€“ W_3

Answer: c
Explanation: For energy balance, $m_1 W_1 + m_2 W_2 = m_3 W_3$
$m_3 = m_1 + m_2$
So, $m_1 W_1 + m_2 W_2 = (m_1 + m_2) W_3$
By solving we get,
m_1 / m_2 = W_3 â€“ W_2 / W_1 â€“ W_3 .

3. Which of the following is true for the adiabatic mixing of two streams?
a) $m_3 = m_3$ â€“ m_1
b) $m_2 = m_1 + m_3$
c) $m_1 = m_3 + m_2$
d) $m_3 = m_1$ â€“ m_2

Answer: a
Explanation: As two streams are mixed, then the result of it is the summation of mixed masses, and using the energy balance ratio of masses can be obtained. So, $m_3 = m_1 + m_2$.

4. When the adiabatic mixing is carried out, the air having ______ enthalpies and ____________ specific humidities are mixed.
a) similar, similar
b) different, similar
c) similar, different
d) different, different

Answer: d
Explanation: The two air streams getting mixed adiabatically have different enthalpies and different specific humidities to get the final condition of air.

5. What is the value of m_1 / m_2 if $h_1 = 81$ kJ/ kg of dry air, $h_2 = 46$ kJ/ kg of dry air and $h_3 = 58$ kJ/ kg of dry air?
a) 1
b) 0
c) 0.51
d) 0.52

Answer: d
Explanation: As we know, $m_1 / m_2 = h_3$ â€“ h_2 / h_1 â€“ h_3
= 58 â€“ 46 / 81 â€“ 58
= 0.5217 = 0.52.

6. What is the value of m_1 / m_2 if $W_1 = 0.0157$ kg/ kg of dry air, $W_2 = 0.0084$ kg / kg of dry air and $W_3 = 0.0103$ kJ/ kg of dry air?
a) 0.31
b) 0.28
c) 0.35
d) 0.52

Answer: c
Explanation: As we know, $m_1 / m_2 = W_3$ â€“ W_2 / W_1 â€“ W_3
= 0.0103 â€“ 0.0084 / 0.0157 â€“ 0.0103
= 0.0019 / 0.0054 = 0.3518 = 0.35.

7. What is the value of one of the mass before mixing if the other mass is 1.98 kg, and the final is 4.22 kg?
a) 2.24
b) 1.98
c) 4.22
d) 6.20

Answer: a
Explanation As two streams are mixed, then the result of it is the summation of mixed masses, and using the energy balance ratio of masses can be obtained. So, $m_3 = m_1 + m_2$
If, $m_1 = 1.98$ and $m_3 = 4.22$ then, $m_2 = 4.22$ â€“ 1.98 = 2.24 kg.

8. What is the value of final enthalpy if the enthalpies before mixing were 50 and 28 kJ / kg of dry air respectively and $m_2 / m_1 = 2$?
a) 38.67
b) 48.67
c) 40.05
d) 52

Answer: a
Explanation: For energy balance, $m_1 h_1 + m_2 h_2 = m_3 h_3$
$m_3 = m_1 + m_2$
So, $m_1 h_1 + m_2 h_2 = (m_1 + m_2) h_3$
$m_1 / m_2 = h_3$ â€“ h_2 / h_1 â€“ h_3
$0.5 = h_3$ â€“ $28 / 50$ â€“ h_3
50 â€“ $h_3 = 2h_3$ â€“ 56
$3h_3 = 50 + 56 = 116$
$h_3 = 38.67$.

9. Even a lesser quantity of steam may result in the formation of fog.
a) True
b) False

Answer: a
Explanation: Fog also results when steam or very fine water spray is injected into the air in a greater quantity than required to do the saturation of the air. So, even less quantity of steam without mixing properly can result in fog.

10. Fog can be cleared by cooling.
a) True
b) False

Answer: b
Explanation: Fog can be cleared by heating or mixing it with unsaturated air or mechanically separating water droplets from the air.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œPsychrometry â€“ Inside and Outside Summer Design Conditionsâ€�.

1. Which of the following has the highest DBT in the chart of outside summer design conditions?
a) Agra
b) Ambala
c) Banaras
d) Bangalore

Answer: b
Explanation: From the table of outside summer design conditions, the highest DBT among the given options is at Ambala with 43.3Â°C, whereas the temperatures of Agra, Banaras, Bangalore are 41.5Â°C, 40.8Â°C and 32.9Â°C respectively.

2. Which of the following has the lowest DBT in the chart of outside summer design conditions?
a) Cochin
b) Darjeeling
c) Jaipur
d) Srinagar

Answer: b
Explanation: From the table of outside summer design conditions, the lowest DBT among the given options is at Darjeeling with 17.2Â°C, whereas the temperatures of Cochin, Jaipur, Srinagar are 35Â°C, 40.8Â°C and 25Â°C respectively.

3. Which of the following has the highest WBT in the chart of outside summer design conditions?
a) Ahmednagar
b) Baroda
c) Cuttack
d) Trivandrum

Answer: a
Explanation: From the table of outside summer design conditions, the highest WBT among the given options is at Ahmednagar with 31.1Â°C, whereas the temperatures of Baroda, Cuttack, Trivandrum are 29.1Â°C, 30.6Â°C and 29.4Â°C respectively.

4. Which of the following has the lowest WBT in the chart of outside summer design conditions?
a) Cochin
b) Srinagar

c) Mahabaleshwar
d) Darjeeling

Answer: d
Explanation: From the table of outside summer design conditions, the lowest WBT among the given options is at Darjeeling with 14.5Â°C, whereas the temperatures of Cochin, Mahabaleshwar, Srinagar are 27.8Â°C, 19.2Â°C and 18.4Â°C respectively.

5. What is the value of optimum effective temperature in winter?
a) 17
b) 18
c) 19
d) 20

Answer: c
Explanation: From the table of design conditions for comfort, we get to know that in winter, the optimum effective temperature is 19Â°C.

6. Which of the following has the highest relative humidity in the chart of outside summer design conditions?
a) Aligarh
b) Bhopal
c) Chennai
d) Trivandrum

Answer: d
Explanation: From the table of outside summer design conditions, the highest RH among the given options is at Trivandrum with 90% whereas, Aligarh, Bhopal, Chennai have 35%, 24% and 47% respectively.

7. Which of the following has the lowest relative humidity in the chart of outside summer design conditions?
a) Jaipur
b) Chandigarh
c) Indore
d) Mysore

Answer: a
Explanation: From the table of outside summer design conditions, the lowest RH among the given options is at Jaipur with 18% whereas, Chandigarh, Indore, Mysore have 27%, 32% and 52% respectively.

8. What is the value of the optimum effective temperature in summer?
a) 23
b) 22
c) 21
d) 24

Answer: b
Explanation: From the table of summer design conditions for comfort, we get to know that in summer, the optimum effective temperature is 22Â°C.

9. Which of the following has the highest effective temperature in the chart of outside summer design conditions?
a) Ahmedabad
b) Allahabad
c) Banaras
d) Cuttack

Answer: a
Explanation: From the table of outside summer design conditions, the highest ET among the given options is at Ahmedabad with 32.5Â°C, whereas the temperatures of Allahabad, Banaras, Cuttack are 30.8Â°C, 31.9Â°C and 32Â°C respectively.

10. Which of the following has the lowest effective temperature in the chart of outside summer design conditions?
a) Srinagar
b) Shimla
c) Darjeeling
d) Surat

Answer: c
Explanation: From the table of outside summer design conditions, the lowest ET among the given options is at

Darjeeling with 16.8Â°C, whereas the temperatures of Srinagar, Shimla, Surat are 22.2Â°C, 19.2Â°C and 30.5Â°C respectively.

11. Which of the following is the odd man out in terms of dry bulb temperature?
a) Ambala
b) Rajpur
c) Jodhpur
d) Pune

Answer: d
Explanation: Ambala, Rajpur and Jodhpur have a similar value of dry bulb temperature, which is 43.3Â°C, and Pune has 37.1Â°C. So, the odd man out of the given options is Pune.

12. Relative humidity at Agra is _____________ the relative humidity at Kanpur.
a) higher than
b) lower than
c) equal to
d) much higher than

Answer: c
Explanation: Relative humidity at Agra is equal to the relative humidity at Kanpur, having a value of 17%.

13. Which of the cities has the lowest WBT in the chart?
a) Surat
b) Shimla
c) Lucknow
d) Mumbai

Answer: b
Explanation: From the table of outside summer design conditions, the lowest WBT is at Shimla with 12.5Â°C, whereas the temperatures of Surat, Lucknow, Mumbai are 21.6Â°C, 28.3Â°C and 26.7Â°C respectively.

14. Effective temperature at Patna, Pune, Rajpur and Surat is similar.
a) True
b) False

Answer: a
Explanation: The value of Effective temperature at Patna, Pune, Rajpur and Surat is 30.5Â°C.

15. Relative humidity above 30% is not desired in summer comfort cooling.
a) True
b) False

Answer: b
Explanation: In summer comfort cooling, the air of the occupied space should not have relative humidity above 60%.

This set of Air-Conditioning Questions and Answers for Aptitude test focuses on â€œComfort Conditions â€“ Factors Affecting Optimum Effective Temperatureâ€�.

1. What is the value of optimum effective temperature in winter?
a) 17
b) 18
c) 19
d) 20

Answer: c
Explanation: From the table of design conditions for comfort, we get to know that in winter, the optimum effective temperature is 19Â°C.

2. What is the value of the optimum effective temperature in summer?
a) 23
b) 22
c) 21
d) 24

Answer: b
Explanation: From the table of summer design conditions for comfort, we get to know that in summer, the optimum effective temperature is 22Â°C.

3. Which of the following provides the relationship between the optimum indoor effective temperature and optimum outdoor effective temperature?
a) Clothing
b) Occupants
c) Duration of stay
d) Climatic and seasonal differences

Answer: d
Explanation: As season changes, then the relationship between the optimum indoor effective temperature and optimum outdoor effective temperature changes. This affects the optimum effective temperature for comfort.

4. A person with _________ clothing needs ___________ optimum temperature.
a) heavy, higher
b) heavy, lesser
c) light, higher
d) light, lesser

Answer: d
Explanation: Clothing is one of the factors affecting the effective temperature. So, to note, a person with light clothing needs lesser optimum temperature.

5. A person with heavy clothing needs ____________ optimum temperature as compared to a person with light clothing.
a) higher
b) lesser
c) zero
d) same

Answer: a
Explanation: Clothing is one of the factors affecting the effective temperature. So to note, a person with heavy clothing needs a higher optimum temperature than a person with light clothing.

6. Men need a higher effective temperature than women.
a) True
b) False

Answer: b
Explanation: Women actually need higher effective temperature than men to be comfortable.

7. What is the value of an increase in effective temperature do women need than men?
a) about 1Â°C
b) about 0.25Â°C
c) about 0.5Â°C
d) about 2Â°C

Answer: c
Explanation: Women actually need higher effective temperature than men to be comfortable. This value differs approximately about 0.5â�°C.

8. Which of the following is true about effective temperature between young and older people?
a) $T_{young} > T_{old}$
b) $T_{young} < T_{old}$
c) T_{young} â‰ª T_{old}
d) $T_{young} = T_{old}$

Answer: a
Explanation: As there is a difference between effective temperature as per gender then it also happens in the age sector. Young people need a higher effective temperature than older people.

9. What is the value of an increase in effective temperature do children need than older ones in case of maternity halls?
a) 1 to 2Â°C
b) 2 to 3Â°C

c) 3 to 4Â°C
d) 0 to 1Â°C

Answer: b
Explanation: As there is a difference between effective temperature as per gender then it also happens in the age sector. Young people need a higher effective temperature than older people, i.e., $T_{young} > T_{old}$
Hence, maternity halls are maintained 2 to 3Â°C more than the effective temperature needed for adults.

10. People living in colder climate regions feel comfortable at lower effective temperature.
a) True
b) False

Answer: a
Explanation: Climatic and seasonal differences affect the effective temperature. People living in colder climate areas are comfortable with low effective temperatures than people living in warmer areas.

11. What is the effective temperature needed if the duration of stay in a room is short?
a) Higher
b) Lower
c) Much lower
d) Has no effect of duration of stay

Answer: a
Explanation: Duration of stay does affect the effective temperature. So, if the duration is short, then a higher effective temperature is needed.

12. What is the effective temperature needed if a person is entering his office?
a) Higher
b) Lower
c) Much higher
d) Has no effect of duration of stay

Answer: b
Explanation: Duration of stay does affect the effective temperature. So, if the duration is short, then a higher effective temperature is needed and vice-versa. When the person is entering his office, will be in the office for at least a few hours, i.e., longer duration of stay and hence, the person will need a low effective temperature.

13. What is the effective temperature needed if a person is doing a heavy activity like working with heavy loads?
a) Higher
b) Lower
c) Much higher
d) Has no effect of kind of activity

Answer: b
Explanation: Kind of activity a person does, affect the effective temperature. If the person works on heavy loads in a factory or gym, then that person will need a low effective temperature.

14. What is the effective temperature needed if a person is sitting in a cinema hall?
a) Higher
b) Lower
c) Much lower
d) Has no effect of kind of activity

Answer: a
Explanation: Kind of activity a person does, affect the effective temperature. If the person works on heavy loads in a factory or gym, then that person will need a low effective temperature. On the contrary, if a person is doing less activity like sitting in a hall to watch movies, then that person will need a higher effective temperature than people doing heavy work.

15. What is the effective temperature needed in a hall with a high density of occupants?
a) Higher
b) Lower
c) Much higher
d) Has no effect of density of occupants

Answer: a
Explanation: A hall filled with a huge number of people require lower effective temperature than a hall having lesser density. Due to the radiant heat transfer from person to person.

This set of Air-Conditioning Multiple Choice Questions & Answers (MCQs) focuses on â€œComfort Air-Conditioningâ€�.

1. Which of the following is true about the optimum effective temperature for human comfort?
a) Same in winter and summer
b) Not dependent on season
c) Lower in winter than in summer
d) Higher in winter than in summer

Answer: c
Explanation: Optimum effective temperature is dependent on climatic and seasonal changes. So, for human comfort, the optimum effective temperature is lower in winter than in summer.

2. The heat production from a normal healthy man when asleep is about __________
a) 50 W
b) 40 W
c) 70 W
d) 60 W

Answer: d
Explanation: A normal healthy man when asleep produces heat nearly equal to 60 W. This might vary depending on various parameters.

3. When the heat stored in the body is _________ the human body feels comfortable.
a) zero
b) infinite
c) positive
d) negative

Answer: a
Explanation: The human body feels comfortable when the heat stored in the body is zero. This is the desired comfort condition.

4. Which of the following does not mainly a factor of dependency for the degree of warmth or cold?
a) Relative humidity
b) WBT
c) Air velocity
d) DBT

Answer: d
Explanation: The degree of warmth or cold felt by the human body depends mainly on dry bulb temperature, air velocity and relative humidity.

5. The effective temperature increases with a decrease in relative humidity at the same DBT.
a) True
b) False

Answer: b
Explanation: At the same value of dry bulb temperature, the effective temperature decreases with a decrease in relative humidity to achieve desired comfort conditions.