PRACTICE QUESTIONS

for SSC-JE : CBT-2

Refrigeration and Air-Conditioning

Mechanical Engineering

10 Refrigeration and Air-Conditioning

Q.1 Consider the following statements:
The Carnot cycle for refrigeration is ideal but non-practical because:
1. It is not possible to control condensation process is such a manner to get desired quality of steam.
2. It is not possible to add heat at constant temperature with decrease in pressure.
3. Pump work becomes negligible in it.

Which of the above statements are correct?
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

Q.2 For an air conditioned space, SH = 75 kW, RSHF = 0.75, Volume flow rate is equal to 200 m^3/min and specific humidity of supplied air is 0.005 kg/kg of dry air. What will be the specific humidity of indoor design?
(a) 0.045 (b) 0.066
(c) 0.0075 (d) 0.070

Q.3 When moist air in a closed vessel is cooled, the specific humidity:
(a) increases
(b) decreases
(c) initially increases then decreases
(d) remains constant

Q.4 The humidity ratio of atmospheric air at 28°C and 760 mm Hg is 0.016 kg/kg of da. What is the partial pressure of the water vapour in mm of Hg?
(a) 17.23 (b) 19.06
(c) 21.53 (d) 23.53

Q.5 Evaporative regulation of body temperature fails when the body temperature is
(a) more than WBT but less than DBT.
(b) more than DPT but less than WBT.
(c) more than DPT but less than DBT.
(d) less than DPT

Q.6 The refrigerating efficiency cycle is 0.8, the condenser and evaporator temperature are 51°C and –30°C respectively. What is the work requirement for cooling capacity of 2.4 kW?
(a) 0.5 kW (b) 1 kW
(c) 1.5 kW (d) 2.0 kW

Q.7 The enthalpies at the beginning of compression, at the end of compression and at the end of condensation are 185 kJ/kg, 210 kJ/kg and 85 kJ/kg respectively. The COP of the VCRS heat pump is
(a) 0.25 (b) 5.0
(c) 4.0 (d) 1.35

Q.8 In vapour absorption refrigerator heat is rejected in
(a) Condenser only
(b) Absorber only
(c) Generator only
(d) Condenser and Absorber

Q.9 Air washer can work as
1. Humidifier only
2. Dehumidifier only
3. Filter only

Which of the above statement(s) is/are correct?
(a) 1 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.10 The bypass factor of single cooling coil in an air conditioner is 0.4. The bypass factor if three such cooling coils with the same apparatus dew

point are kept one behind other will be
(a) 0.064 (b) 0.216
(c) 0.784 (d) 0.936

Q.11 In an air conditioning process, 5 kJ/min heat is extracted from a room. If the sensible heat factor is 0.8. Then the latent heat extracted will be
(a) 4 kJ/min (b) 2 kJ/min
(c) 1 kJ/min (d) 0.25 kJ/min

Q.12 In summer, air may be cooled and dehumidified by spraying chilled water to air in the form of mist. The minimum temperature to which air may be cooled is the
(a) Wet bulb temperature
(b) Adiabatic saturation temperature
(c) Apparatus dew point
(d) Dry bulb temperature

Q.13 Which of the following refrigerants are suggested as replacements for R22 in large air conditioning and cold storage systems?
1. R134 a 2. R 21
3. R 410 a 4. R 407 c
(a) 1 and 3 (b) 2 and 4
(c) 2 and 3 (d) 3 and 4

Q.14 Consider the following statements about regenerative cooling system:
1. The regenerative system is used if the cooling turbine discharge temperature of a simple system is too high.
2. It consists of only a regenerative heat exchanger and a cooling turbine.
3. Part of cold air from turbine discharge is used as the heat sink in the regenerative heat exchanger.

Which of the above statements are correct?
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

Q.15 Consider the following statements about secondary refrigerants:
1. The point at which the freezing temperature is minimum is called as eutectic temperature.
2. Propylene glycol is used as brine in skating ring.
3. Antifreeze are used for increasing the freezing point of water for certain refrigeration uses.

Which of the above statements is/are incorrect?
(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

Q.16 If the COPs of lower and upper refrigeration cycles of a cascade refrigeration system are 3 and 4, then the combined COP of the system is
(a) 1.67 (b) 1.5
(c) 2 (d) 2.25

Q.17 In an ideal VCR cycle, the specific enthalpy of refrigerant (kJ/kg) at the following states is given as:

Compressor inlet	:	332
Condenser inlet	:	383
Condenser exit	:	216

The COP of the cycle is
(a) 2.27 (b) 2.47
(c) 2 (d) 2.25

Q.18 The designation of a refrigerant is given by R-114. Its chemical formula is
(a) $CHClF_2$ (b) CCl_2F_2
(c) $C_2Cl_3F_3$ (d) $C_2Cl_2F_4$

Q.19 The sensible heat load due to infiltrated air is 0.6 kW and the air conditioned room of volume 10 m^3 has infiltration of air equivalent to 3 air changes/hour. Density of air is 1.2 kg/m^3 what will be the temperature difference between room and ambient air?
(a) 60 K (b) 58 K
(c) 56 K (d) 54 K

Q.20 The supply air temperature is 16°C and ADP is 12°C for the cooling coil with bypass factor 0.18. What is the temperature at inlet of cooling coil?
(a) 30°C (b) 32.33°C
(c) 34.22°C (d) 37.36°C

Q.21 In winter air-conditioning, the following changes may take place:

1. Temperature and humidity ratio rise.
2. The final relative humidity can be lower or higher than the initial value.
3. Both DBT and WBT will increase.

Which of these statements is correct?

(a) 1 only (b) 3 only
(c) 1 and 3 (d) 2 and 3

Q.22 For ammonia refrigeration system, the pipe for carrying refrigerant should be made of

(a) Brass (b) Copper
(c) Aluminium (d) Steel or wrought iron

Q.23 The operating temperature of a cold storage is –9°C and load for the refrigerant plant is 20 kW for ambient temperature of 24°C. The actual COP of the plant used is one fourth that of ideal plant working between the same temperatures. The power required to drive the plant is

(a) 10 kW (b) 5 kW
(c) 2.5 kW (d) 3 kW

Q.24 Efficiency of a Carnot engine is 70%. If the direction of the cycle is reversed, what will be the heat rejection ratio of reversed Carnot cycle?

(a) 1.33 (b) 0.7
(c) 1.7 (d) 3.33

Q.25 The optimum effective temperature for human comfort is

(a) higher in winter than in summer.
(b) same in winter and summer.
(c) lower in winter than in summer.
(d) not dependent on season.

Q.26 Consider the following statements about mechanism of heat loss from human body:

1. The heat loss by human body to the surroundings is mainly by convection and radiation.
2. Sensible heat loss and latent heat loss are two main component of human body heat loss to the surroundings.
3. Evaporative losses tends toward zero during winter season.
4. Sensible heat component of human body heat loss depends on the difference in water vapour pressures.

Which of the above statements are correct?

(a) 1 and 4 only (b) 1 only
(c) 2 and 3 only (d) 2, 3 and 4 only

Q.27 Comfort chart is drawn between

(a) DBT on *x*-axis and relative humidity on *y*-axis.
(b) WBT on *y*-axis and relative humidity on *x*-axis.
(c) DBT on *y*-axis and WBT on *x*-axis.
(d) DBT on *x*-axis and WBT on *y*-axis.

Q.28 Which one of the following statement is correct regarding psychrometric temperatures?

(a) Thermodynamic WBT is a property of moist air, while WBT as measured by wet bulb thermometer is not a property.
(b) Both the thermodynamic WBT and WBT as measured by wet bulb thermometer are properties of moist air.
(c) Under no circumstances, dry bulb and wet bulb temperatures are equal.
(d) WBT is always lower than dry bulb temperature, but higher than dew point temperature.

Q.29 If moist air is sensibly cooled above its dew point temperature lies at the intersection point of

(a) RSHF and GSHF lines.
(b) RSHF and ESHF lines.
(c) GSHF line with the saturation curve.
(d) Room dry bulb line with the saturation curve.

Q.30 Which of the following statements is not TRUE in the context of vapour compression refrigeration cycle?

(a) The refrigerant exits as high pressure saturated liquid from the condenser.
(b) The refrigerant is generally in the form of wet vapour in the evaporator.
(c) The refrigerant exits as high pressure liquid in the condenser.
(d) The refrigerant is at very high temperature when it leaves the throttle valve.

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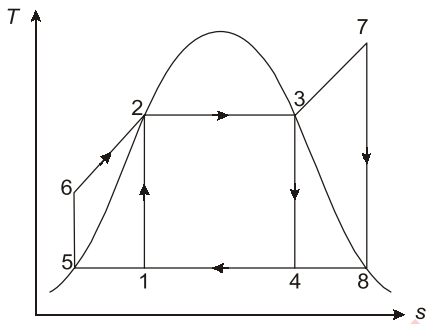
Answer Keys

1.	(a)	2.	(c)	3.	(d)	4.	(b)	5.	(d)	6.	(b)	7.	(b)
8.	(d)	9.	(d)	10.	(a)	11.	(c)	12.	(c)	13.	(d)	14.	(c)
15.	(c)	16.	(b)	17.	(a)	18.	(d)	19.	(a)	20.	(c)	21.	(c)
22.	(d)	23.	(a)	24.	(d)	25.	(c)	26.	(c)	27.	(d)	28.	(a)
29.	(c)	30.	(d)										

Detailed Solutions

1. (a)



Process 1-2 shows pump work, which becomes very large in Carnot cycle and it also makes Carnot cycle impractical.

2. (c)

$$\text{RSHF} = \frac{SH}{SH + LH}$$

$$0.75 = \frac{75}{75 + LH}$$

$$LH = 25 \text{ kW}$$

Now, latent heat, $LH = 50(\text{cmm}) \times \Delta\omega$

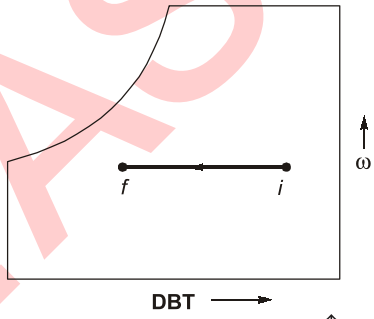
$$\Delta\omega = \frac{25}{50 \times 200} = 0.0025 \text{ kg/kg of dry air}$$

$$\frac{25}{50 \times 200} = (\omega_{room} - \omega_{supply}) = 0.0025$$

$$\omega_{room} = 0.0025 + 0.005$$

$$\omega_{room} = 0.0075 \text{ kg/kg of dry air}$$

3. (d)



DBT ↓; ω = Remains constant; RH ↑; enthalpy ↓; Specific volume ↓

4. (b)

$\omega = 0.016$ kg/kg of d.a.

$P = 760$ mm of Hg

$$\omega = 0.622 \times \frac{P_v}{P - P_v}$$

$$0.016 = 0.622 \times \frac{P_v}{760 - P_v}$$

$P_v = 19.06$ mm of Hg

5. (d)

DPT of the moist air is equal to the saturation temperature corresponding to the partial pressure of the vapour in the moist air. Therefore, evaporation will not take place when body temperature is below DPT.

6. (b)

$$(\text{COP})_{rev} = \frac{T_2}{T_1 - T_2} = \frac{243}{324 - 243} = 3$$

$$\eta_r = \frac{COP}{(COP)_{rev}}$$

$\Rightarrow$ COP = 0.8 × 3 = 2.4

$$W = \frac{Q_2}{COP} = \frac{2.4}{2.4} = 1\,kW$$

7. (b)

$$COP = \frac{210-85}{210-185} = \frac{125}{25} = 5$$

8. (d)

In a vapour absorption refrigeration system, the heat is rejected in condenser then in absorber also.

9. (d)

The functions of air washer are to cool, humidity, dehumidify and clean the air.

10. (a)

By pass factor = $x^n = 0.4^3 = 0.064$

11. (c)

Sensible heat = SHF × 5 kJ/min = 0.8 × 5 = 4 kJ/min

Latent heat = 5 – 4 = 1 kJ/min

12. (c)

The moist air cannot be cooled down below the apparatus dew point.

13. (d)

Substitutes for R22 in air conditioning systems and heat pumps are R407C, R410A, R417A, R417B, R422D, R438A and R427A.

14. (c)

The regenerative air cycle refrigeration system consists of a primary air-to-air heat exchanger in addition to a regenerative heat exchanger and a cooling turbine.

15. (c)

- Propylene glycol is used as brine in breweries.
- Calcium chloride and Ethylene glycol is used as brine in skating ring.
- Antifreeze are used for decreasing the freezing point of water for certain refeigeration uses.

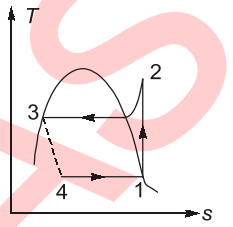
16. (b)

Given: $C_L = 3$ $C_U = 4$

Combined COP

$$= \frac{C_L \times C_U}{C_L + C_U + 1} = \frac{3\times 4}{3+4+1} = 1.5$$

17. (a)



$$COP = \frac{h_1 - h_4}{h_2 - h_1} = \frac{332-216}{383-332} = 2.27$$

18. (d)

Since, $R_{114} = R_{(m-1)\,(n+1)q}$

$\therefore$ $m - 1 = 1 \Rightarrow m = 2$

$n = 0, \quad q = 4$

$\Rightarrow p = 2(2) + 2 - 0 - 4 = 2$

So the chemical formula is,

$C_mH_nCl_pF_q = C_2Cl_2F_4$

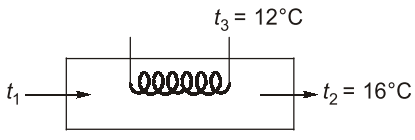
19. (a)

$$SHL = mc_p\Delta T$$

$$0.6 = \frac{(3\times 10)}{3600}\times 1.2\times 1\times \Delta T$$

ΔT = 60 K

20. (c)



For cooling coil,

$$BPF = \frac{t_2 - t_3}{t_1 - t_3} \Rightarrow 0.18 = \frac{16-12}{t_1 - 12}$$

t_1 = 34.22°C

21. (c)

In winter air conditioning, the final value of relative humidity will be higher than initial value.

22. (d)

Ammonia reacts with copper and aluminium hence whenever ammonia is used, pipe for carrying refrigerant is made up of steel or wrought iron.

23. (a)

$T_L = -9°C = 264\ K$

$T_H = 24°\ C = 297\ K$

$$(COP)_{actual} = \frac{1}{4}(COP)_{ideal} = \frac{1}{4}\left(\frac{T_L}{T_H - T_L}\right)$$

$$(COP)_{actual} = \frac{264}{297-264} \times \frac{1}{4}$$

$$\Rightarrow \quad \frac{\text{Refrigertor Capacity}}{\text{Power}} = \frac{1}{4} \times \frac{264}{33}$$

$$\text{Power} = \frac{4 \times 33 \times 20}{264} = 10\ kW$$

24. (d)

Since, $1 + (COP)_{Ref} = \dfrac{1}{\eta_{H.E}}$

$$(COP)_{Ref} = \frac{1}{0.7} - 1 = \frac{3}{7}$$

$$H.R.R = 1 + \frac{1}{(COP)_{Ref}} = 1 + \frac{1}{\frac{3}{7}} = 3.33$$

25. (c)

The optimum effective temperature for human comfort in winter and summer is 20°C and 21.6°C, respectively.

26. (c)

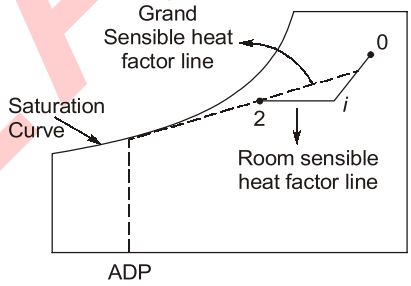
(i) The total heat loss Q = sensible heat + latent heat, sensible heat depends on convection, radiation and respiration.

(ii) Latent heat depend on evaporation of moisture.

(iii) In summer, evaporative losses are maximum.

(iv) In winter, evaporative losses are zero.

29. (c)



Hence apparatus dew point temperature lies at the intersection point of Grand sensible heat factor line and saturation curve.

30. (d)

It is low temperature side when the refrigerant vapour leaves the throttle valve.

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