

# OBJECTIVE TYPE QUESTIONS

## UNIT -1

SUBJECT: REFRIGERATION AND AIR CONDITIONING

UNIT-I: AIR REFRIGERATION

- Reversed Carnot cycle comprises
  - Two isentropic processes and two adiabatic processes
  - Two isentropic processes and two isothermal processes
  - Two isentropic processes and two isobaric processes
  - Two isentropic processes and two isochoric processes
- Two Carnot Refrigerators are employed, one for ice making and other for comfort cooling
  - The COP of the refrigerator for ice making is higher than that for other
  - The COP of the refrigerator for ice making is same as that for the other
  - The COP of the refrigerator for ice making is lower than that for other
  - The COP of Carnot refrigerator will depend on refrigerant used
- A reversed Carnot cycle has a COP of 4. The ratio of higher temperature to lower temperature will be
  - 1.25
  - 1.5
  - 2
  - 2.5
- Carnot refrigerator absorbs heat at  $-13^{\circ}\text{C}$  and requires 1 kW for each 6.5 kW of heat absorbed, the COP and temperature of heat rejections respectively
  - COP = 6.5,  $t = 27^{\circ}\text{C}$
  - COP = 7.5,  $t = 27^{\circ}\text{C}$
  - COP = 6.5,  $t = 30^{\circ}\text{C}$
  - COP = 7.5,  $t = 37^{\circ}\text{C}$
- The dense air refrigeration system as compared to open air refrigeration system for same Range of temperatures using Bell- Coleman cycle requires.
  - Same power/Ton of Refrigeration
  - Lower power/Ton of Refrigeration
  - Higher power/Ton of Refrigeration
  - Unpredictable Results.
- For very high speed planes cruising at Mach number 2.5 and above, the air craft refrigeration system recommended is
  - Simple evaporative type
  - Boot-strap type
  - Regenerative type
  - Boot strap evaporative type
- The air craft system giving Lowest Dry Air Rated Turbine discharge temperature at supersonic cruising speeds of the plane, is
  - Reduced ambient system of Refrigeration
  - Boot-strap system of Refrigeration
  - Regenerative system of Refrigeration
  - Boot strap evaporative system of Refrigeration
- There are two cooling turbines in
  - Reduced ambient system of Refrigeration
  - Boot-strap system of Refrigeration
  - Regenerative system of Refrigeration
  - Boot strap evaporative system of Refrigeration
- There are two stages of compression of air in
  - Reduced ambient system of Refrigeration
  - Boot-strap system of Refrigeration
  - Regenerative system of Refrigeration
  - Simple evaporative system of Refrigeration
- The amount of heat absorbed by the system at low temperature is
  - COP
  - refrigerating effect
  - Work done on the system
  - refrigeration efficiency
- No refrigerator using reversed Carnot cycle has been constructed because



- C) Regenerative system of Refrigeration                      D) Boot strap evaporative system of Refrigeration
22. There are two stages of compression of air in  
 A) Reduced ambient system of Refrigeration                      B) Boot-strap system of Refrigeration  
 C) Regenerative system of Refrigeration                      D) Simple evaporative system of Refrigeration
23. A Bell-Colemann cycle is  
 A) Reversed Carnot Cycle    B) Reversed Joule Cycle  
 C) Reversed Rankine cycle    D) None of the above
24. In a refrigeration cycle the heat is rejected by refrigerant at  
 A) expansion valve                      B) compressor  
 C) condenser                      D) all the above
25. A refrigeration cycle is usually a  
 A) open cycle B) closed cycle C) mixed cycle D) Hybrid cycle
26. A reversible refrigerator working between two fixed temperatures  
 A) has the same COP whatever the working substance  
 B) has its COP increased for working substance with high enthalpy of evaporation  
 C) has its COP increased for working substance with higher specific heats  
 D) none of the above
27. 1.0 Ton of Refrigeration is equal to  
 A) 50 kcal/min                      B) 50 kcal/hr C) 80 kcal/min                      D) 80 kcal/hr
28. Which of the following cycles uses 'air' as the refrigerant?  
 A) Ericson    B) Stirling    C) Carnot    D) Bell Coleman
29. In a reversed Brayton cycle, the heat absorption occurs during  
 A) Isentropic compression process    B) Constant pressure cooling process  
 C) Isentropic expansion process                      D) Constant pressure expansion process
30. Air refrigeration cycle is used in  
 A) Domestic refrigerators                      B) Commercial refrigerators  
 C) Gas liquefaction                      D) Air conditioning

### UNIT – II: VAPOUR COMPRESSION REFRIGERATION

1. Heat is absorbed by the refrigerant, during vapor compression refrigeration cycle in  
 A) Compressor                      B) Condenser C) Evaporator                      D) Throttle valve
2. In a simple saturated vapor compression cycle, the refrigerant is in superheated condition  
 A) before entering compressor B) before entering condenser  
 C) before entering throttle valve D) before entering evaporator
3. Sub-cooling is a process of cooling the refrigerant in vapour compression refrigeration system  
 A) after compression                      B) before compression                      C) before Throttling                      D) none of the above
4. The order in which main components of vapor compression refrigeration system are used is  
 A) compressor-evaporator-condenser-throttle valve  
 B) compressor-condenser-evaporator-throttle valve  
 C) compressor-throttle valve- evaporator-condenser  
 D) compressor-condenser- throttle valve- evaporator
5. The oil separator is incorporated in vapour compression refrigeration system  
 A) between evaporator and compressor                      B) between compressor and condenser  
 C) between condenser and Throttle valve                      D) between throttle valve and evaporator
6. In vapour compression refrigeration cycle the following data is available  
 Heat rejected in condenser = 65 KW, Work done in compressor = 10 kw, then COP( refrigerator) is

- A) 4.5 B) 5.5 C) 6.5 D) not possible to find with the given data
7. Following results are tabulated for vapour compression refrigeration cycle. Enthalpy at suction = 190 kJ/kg, Enthalpy at discharge from compressor = 210 kJ/kg, Enthalpy at exit from condenser = 80 kJ/kg, COP of cycle would be  
A) 3.5      B) 4.5      C) 5.5      D) 6.5
8. For simple saturated vapour compression refrigeration cycle operating between 5°C and 40°C, and the refrigerants being R-11, R-12, R-717 and R-22, the evaporator pressure is lowest for  
A) R-11      B) R-12      C) R-717      D) R-22
9. For simple saturated vapour compression refrigeration cycle operating between 5°C and 40°C, and the refrigerants being R-11, R-12, R-717 and R-22, the compressor displacement per min per ton of refrigeration is highest for  
A) R-11      B) R-12      C) R-717      D) R-22
10. With reciprocating compressor in vapour compression refrigeration system, wet compression is not desirable because  
A) Liquid trapped up in the head of cylinder may damage the compressor valves  
B) COP of the cycle decreases  
C) Volumetric efficiency of compressor decreases  
D) Mass flow rate per ton of refrigerant increases
11. An ideal refrigerant should have  
A) low latent heat of vaporization      B) high critical temperature  
C) high boiling point      D) high specific volume of vapour
12. The refrigerant leaving throttle valve is  
A) saturated liquid      B) saturated vapour  
C) superheated vapour      D) fraction as saturated vapour and remainder as liquid
13. Freon group of refrigerants  
A) Toxic      B) inflammable      C) non-toxic and non-inflammable  
D) Highly toxic and inflammable
14. The leaks of refrigerant from a cycle may be detected by  
A) Halide torch test      B) Sulphur candle test  
C) Soap and water test      D) any of the above      (e) none of the above
15. During compression in a vapour compression cycle the refrigerant is superheated  
A) work done is increased      B) C.O.P is increased  
C) Work done is reduced      D) Refrigerating effect is reduced
16. Heat is rejected by the refrigerant, during vapor compression refrigeration cycle in  
A) Compressor      B) Condenser      C) Evaporator      D) Throttle valve
17. In a simple saturated vapour compression cycle, the refrigerant is in superheated condition  
A) before entering compressor      B) before entering condenser  
C) before entering throttle valve      D) before entering evaporator
18. Sub-cooling is a process of cooling the refrigerant in vapour compression refrigeration system  
A) after compression      B) before compression      C) before Throttling      D) none of the above
19. Wet compression vapour compression refrigeration cycle means  
A) Vapour compression takes place in wet region  
B) Vapour compression in dry region, but evaporation in wet region  
C) vapour compression in wet region, but leaves in superheated region  
D) None of the above
20. The oil separator is incorporated in vapour compression refrigeration system  
A) Between evaporator and compressor      B) between compressor and condenser

- C) Between condenser and Throttle valve D) between throttle valve and evaporator
21. In vapour compression refrigeration cycle the following data is available, Heat rejected in condenser = 65 KW, Work done in compressor = 10 kw, then COP (refrigerator) is  
 A) 4.5 B) 5.5 C) 6.5 D) not possible to find with the given data
22. Following results are tabulated for vapour compression refrigeration cycle, Enthalpy at suction = 190 kJ/kg, Enthalpy at discharge from compressor = 210 kJ/kg, Enthalpy at exit from condenser = 80 kJ/kg COP of cycle would be  
 A) 3.5 B) 4.5 C) 5.5 D) 6.5
23. For simple saturated vapour compression refrigeration cycle operating between 5°C and 40°C, and the refrigerants being R-11, R-12, R-717 and R-22, the evaporator pressure is highest for  
 A) R-11 B) R-12 C) R-717 D) R-22
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25. With reciprocating compressor in vapour compression refrigeration system, wet compression is not desirable because  
 A) Liquid trapped up in the head of cylinder may damage the compressor valves  
 B) COP of the cycle decreases  
 C) Volumetric efficiency of compressor decreases  
 D) Mass flow rate per ton of refrigerant increases
26. An ideal refrigerant should have  
 A) Low latent heat of vaporization B) lower critical temperature  
 C) Lower boiling point D) high specific volume of vapour
27. The refrigerant leaving throttle valve is  
 A) Saturated liquid B) saturated vapour  
 C) Superheated vapour D) fraction as saturated vapour and remainder as liquid
28. Freon group of refrigerants  
 A) Toxic B) inflammable  
 C) Non-toxic and non-inflammable D) highly toxic and inflammable
29. The leaks of refrigerant from a cycle may be detected by  
 A) Halide torch test B) Sulphur candle test  
 C) Soap and water test D) any of the above (e) none of the above
30. During compression in a vapour compression cycle the refrigerant is superheated  
 A) C.O.P is reduced B) C.O.P is increased  
 C) Work done is reduced D) Refrigerating effect is reduced

### UNIT-III REFRIGERATION SYSTEM COMPONENTS

1. On a p-h plot as pressure increases latent heat \_\_\_\_\_ [ ]  
 a) decreases b) remains constant c) increases d) initially increases then decreases
2. In a simple vapour compression process refrigerant , compressor is used to \_\_\_\_\_. [ ]  
 a) raise the pressure and temperature of the refrigerant  
 b) raise the pressure and lower the temperature of the refrigerant  
 c) lower the enthalpy of the refrigerant d) increase the entropy of the refrigerant
3. The heat rejection factor (HRF) is given by \_\_\_\_\_ [ ]  
 a)  $1 + \text{COP}$  b)  $1 - \text{COP}$  c)  $1 + (\text{COP})^2$  d) equal to COP

4. Most air-cooled condensers are designed to operate with temperature difference of [ ]  
 a) 5 °C      b) 10 °C      c) 14 °C      d) 20 °C
5. Power input to the compressor is equal to product of \_\_\_\_ work input  
 a) Mass                      b) Time                      c) Density      d) Specific Volume
6. In actual vapour compression cycle the compression process is \_\_\_\_\_.  
 a) Isentropic    b) Polytropic    c) Neither Isentropic nor Polytropic    d) Isobaric
7. The effect of clearance volume in reciprocating refrigerant compressors on the work done and the power required for the compressing the refrigerant is \_\_\_\_\_ effect .  
 a) Increases    b) Decreases      c) No Effect      d) Increases and then decreases
8. The throttling device used in the domestic refrigerator is \_\_\_\_\_.  
 a) Capillary tube      b) Automatic Expansion Valve  
 c) Dry Expansion Valve    d) None of the above
9. An automatic expansion valve is required to maintain constant \_\_\_\_\_ in the evaporator  
 a) Pressure      b) Sp Volume    c) Entropy      d) temperature
10. A domestic refrigerator has the co-efficient of performance [ ]  
 a) equal to 1.0    b) less than 1.0    c) more than 1.0    d) any value
11. The pipe material for the refrigerators using ammonia as refrigerant be of [ ]  
 a) copper    b) cast steel or wrought iron    c) brass    d) aluminum
12. The co-efficient of performance (c.o.p) of a refrigerator working on a reserved Carnot cycle is Mathematically equal to [ ]  
 a)  $(T_1 - T_2) / T_1$     b)  $T_1 / (T_2 - T_1)$     c)  $T_2 / (T_1 - T_2)$     d)  $(T_2 - T_1) / T_1$
13. Horse power per ton of refrigeration is expressed as [ ]  
 a)  $4.75 / \text{cop}$     b)  $\text{cop} / 4.75$     c)  $4.75 * \text{cop}$     d)  $47.5 / \text{cop}$
14. Air refrigeration operates on [ ]  
 a) Carnot cycle    b) reversed Carnot cycle    c) Rankine cycle    d) Brayton cycle
15. For better cop of refrigerator, the pressure range corresponding to temperature in evaporator and condenser must be [ ]  
 a) Small    b) high    c) equal    d) anything
16. The bank of tubes at the back of domestic refrigerator are [ ]  
 a) Condenser tubes    b) evaporator tubes    c) capillary tubes    d) throttling device
17. Presence of moisture in a refrigerant affect the working of [ ]  
 a) compressor    b) condenser    c) evaporator    d) expansion valve
18. The refrigerant used in vapour absorption refrigerator is [ ]  
 a) Freon-12    b) ammonia    c) CO<sub>2</sub>    d) aqua-ammonia
19. Heat is absorbed by a refrigerant, during a refrigeration cycle in a [ ]  
 a) Condenser    b) evaporator    c) compressor    d) throttle valve
20. The widely used refrigerant in domestic refrigerator, is

a) Freon 12    b) CO<sub>2</sub>    c) NH<sub>3</sub>    d) R440

21. The refrigerant used for steam jet refrigeration is \_\_\_\_\_

a) Water    b) Steam    c) Ammonia    d) Aqua Ammonia

22. The boiling point of Freon-22 is \_\_\_\_\_

a) -33°C    b) -48.5°C    c) 10°C    d) -40.8°C

23. The refrigerant should have the freezing temperature\_

A) below -35°C    B) below -25°C    C) below -15°C    D) below -5°C

24. The refrigerant with lowest specific volume is \_\_\_\_\_

A)CO<sub>2</sub>    B) SO<sub>2</sub>    C)NH<sub>3</sub>    D)R12

25. The Evaporator used in household refrigerator is

a) Frosting Evaporator    b) Non Frosting Evaporator

c) Defrosting Evaporator    d) Noe of these.

26. The evaporator generally used for wine cooling and in petroleum industry for chilling oil is

a) Plate Evaporator    b) Finned Evaporator

c) Tube-in-Tube Evaporator    d) Shell and Tube Evaporator

27. An Evaporator is also known as

a) Freezing Coil    b) Coooling Coil    c) Chilling Coil    d) All of these.

28. The natural convection air cooled condensers are used in

a) Domestic Refrigerator    b) Water Coolers    c) Room Air Conditioners    d) All of these.

29. The work required for reciprocating compressor is minimum when the compression process is

a) Isothermal    b) Isentropic    c) Polytropic    d) Adiabatic

30. Thermostatic Expansion valve is used in \_\_\_\_\_ type of evaporators.

a) Flooded    b) DX Coil    c) Dry

#### **UNIT – IV VAPOUR ABSORBTION REFRIGERATION SYSTEM.**

1. Co-efficient of performance of vapour absorption refrigeration system as compared to that for vapour compression refrigeration system is [    ]

(a) more    (b) less    (c) may be more or less    (d) un - predictable

2. The function of compressor in vapour compression refrigeration system is performed in vapour absorption system by [    ]

(a) generator (b) absorber (c) generator, absorber and liquid pump (d) absorber and liquid pump 3.

In vapour absorption refrigeration system heating in generator is done at 100°C, refrigeration in evaporator at 10°C and cooling by cooling water in condenser at 30°C. The (COP)<sub>max</sub> is

(a) 0.5    (b) 0.35    (c) 2    (d) in sufficient data [    ]

4. Electrolux system of refrigeration has

(a) only one liquid pump (b) only two liquid pumps (c) no liquid pump(d) none of the above [    ]

5. Electrolux refrigerators has the following working substances

(a) Hydrogen (b) Ammonia and Hydrogen (c) Ammonia and water (d) Ammonia, hydrogen and water [ ]

6. Which of the following system can be called as mechanical system of refrigeration

(a) Vapour absorption system (b) Vapour compression system  
(c) Steam jet refrigeration system (d) None of the above [ ]

7. The vapour absorption refrigeration system using Ammonia – water has cycle operating pressures

(a) higher than that using Lithium Bromide – water  
(b) lower than that using Lithium Bromide – water  
(c) may be higher or lower depending upon application  
(d) higher for sub-zero application and lower for above zero application [ ]

8. Shaft work required for vapour absorption system to produce 1 ton refrigeration may be only

(a) 50 to 60% of that required for vapour compression system  
(b) 20 to 30% of that required for vapour compression system  
(c) 1 to 2% of that required for vapour compression system  
(d) none of the above [ ]

9. Work of compression of the fluid in vapour absorption refrigeration system as compared to that for vapour compression refrigeration system is

(a) less (b) more (c) may be more or less (d) un - predictable [ ]

10. The function of compressor in vapour compression refrigeration system

is performed in vapour absorption system by [ ]

(a) generator (b) absorber (c) generator, absorber and liquid pump (d) absorber and liquid pump 11.

In vapour absorption refrigeration system heating in generator is done at 100°C, refrigeration in evaporator at 10°C and cooling by cooling water in condenser at 30°C. The (COP)<sub>max</sub> is

(a) 0.5 (b) 0.35 (c) 2 (d) in sufficient data [ ]

12. Munters Platen system of refrigeration is

(a) Vapour absorption system with ammonia and water  
(b) Vapour compression system with ammonia as working substance  
(c) Electrolux system with Hydrogen, ammonia and water as working substances  
(d) none of the above [ ]

13. Electrolux refrigerators is

(a) Vapour compression refrigerator with one compressor  
(b) vapour absorption refrigerator with no pump  
(c) vapour absorption refrigerator with one aqua pump  
(d) None of the above [ ]

14. Which of the following system can be called as mechanical system of refrigeration



- (a) Vapour absorption system (b) Vapour compression system  
 (c) Steam jet refrigeration system (d) None of the above [     ]
15. The vapour absorption refrigeration system using Ammonia – water has cycle operating pressures
- (a) higher than that using Lithium Bromide – water  
 (b) lower than that using Lithium Bromide – water  
 (c) may be higher or lower depending upon application  
 (d) higher for sub-zero application and lower for above zero application [     ]
16. Co-efficient of performance of vapour absorption refrigeration system as compared to that for vapour compression refrigeration system is
- (a) more (b) less (c) may be more or less (d) un – predictable [     ]
17. R-718 is designated as which refrigerants
- a) Water     b) Ammonia     c) CO<sub>2</sub>     d) SO<sub>2</sub> [     ]
18. Lithium Bromide – Water absorption refrigeration system refrigerant is
- A) Lithium     b) Bromide     c) Water     d) Lithium Bromide [     ]
19. which device allows only dehydrated ammonia gas to pass to the condenser in Vapour absorption refrigeration system.
- a) Absorber     b) Generator     c) Rectifier     d) heat exchanger [     ]
20. The Purpose of Analyzer in VAR system is
- a) To Remove the water particle     b) To Condensate the Water particle  
 c) To produce Anhydrous Ammonia     d) All the Above. [     ]
21. 1. Which of the following refrigerant used in the steam jet refrigeration?
- a) Ammonia     b) R12     c) Water     d) Air [     ]
22. In a Vapour Absorption refrigerator, heat is rejected in:
- a) Condenser Only     b) Generator Only  
 C) Absorber only     d) Condenser and absorber
23. The load control in steam jet refrigeration cycle is obtained by [     ]
- A. increasing the mass flow rate of motive steam through nozzle  
 B. decreasing the mass flow rate of motive steam through nozzle  
 C. using multiple parallel ejectors  
 D. no method available
25. The ratio of isentropic increase to actual enthalpy increase required for the compression of the motive steam and the water vapours is known as
- a) Nozzle Efficiency     b) Boiler Efficiency  
 c) Entrainment Efficiency     d) Compression efficiency.
26. Steam jet refrigeration cycle and vapour compression refrigeration cycle are quite similar in as much

- A. that both have evaporators where heat is absorbed [ ]
- B. that both have condensers where heat is rejected
- C. that both have compression devices for increasing pressure
- D. that both have compression devices for decreasing pressure
27. In Steam Jet refrigeration system the motive steam expanded in
- a) Convergent Nozzle b) Divergent Nozzle c) Convergent - Divergent Nozzle d) Any Nozzle
28. The velocity of steam at the exit of the nozzle is
- a) Supersonic b) Sonic c) Sub Sonic d) None of these.
29. The COP of steam jet refrigeration system varies from
- a) 0.5 to 0.8 b) 2 to 4 c) 5 to 10 d) None of these.
30. The compression device used in steam jet refrigeration is
- a) Vapour Compressor b) Steam Ejector c) Diffuser d) Liquid Pump

### UNIT-5 : Psychrometric Properties and Processes

1. Dew point temperature of air at one atmospheric pressure (1.013 bar) is 18°C. The air dry bulb temperature, is 30°C. The saturation pressure of water at 18°C and 30°C are 0.02062 bar and 0.04241 bar respectively. The specific heat of air and water vapour respectively are 1.005 and 1.88 kJ/kg K and the latent heat of vaporization of water at 0°C is 2500 kJ/kg. The specific humidity and enthalpy (kJ/kg of dry air) of this moist air respectively, are [GATE 2004]
- (a) 0.01051, 52.64 (b) 0.01291, 63.15 (c) 0.01481, 78.60 (d) 0.01532, 81.40
2. A moist air sample has dry bulb temperature of 30°C and specific humidity of 11.5 g water vapour per kg dry air. Assume molecular weight of air as 28.93. If the saturation vapour pressure of water at 30°C is 4.24 kPa and the total pressure is 90 kPa, then the relative humidity (in %) of air sample is
- (a) 50.5 (b) 38.5 (c) 56.5 (d) 68.5 [GATE-2010]
3. For a typical sample of ambient air (at 35 °C, 75% relative humidity and standard atmospheric pressure), the amount of moisture in kg per kg of dry air will be approximately [GATE-2005]
- (a) 0.002 (b) 0.027 (c) 0.25 (d) 0.75
4. For air at a given temperature, as the relative humidity is increased isothermally, [GATE-2001]
- (a) the wet bulb temperature and specific enthalpy increase
- (b) the wet bulb temperature and specific enthalpy decrease
- (c) the wet bulb temperature increases and specific enthalpy decreases
- (d) the wet bulb temperature decreases and specific enthalpy increases
5. Dew point temperature is the temperature at which condensation begins when the air is cooled at constant [GATE-2006]
- (a) volume (b) entropy (c) pressure (d) enthalpy
6. For air with a relative humidity of 80% [GATE-2003]
- (a) the dry bulb temperature is less than the wet bulb temperature
- (b) the dew point temperature is less than wet bulb temperature
- (c) the dew point and wet bulb temperatures are equal
- (d) the dry bulb and dew point temperatures are equal
7. The statements concern Psychrometric chart. [GATE-2006]

1. Constant relative humidity lines are uphill straight lines to the right
2. Constant wet bulb temperature lines are downhill straight lines to the right
3. Constant specific volume lines are downhill straight lines to the right
4. Constant enthalpy lines are coincident with constant wet bulb temperature lines

Which of the statements are correct?

- (a) 2 and 3 (b) 1 and 2 (c) 1 and 3 (d) 2 and 4

8. When atmospheric air is heated at constant pressure, then which one is not correct. [GATE-2000]

- (a) humidity ratio does not change
- (b) relative humidity increases
- (c) dew point temperature does not change
- (d) wet bulb temperature increases

9. During chemical dehumidification process of air [GATE-2004]

- (a) dry bulb temperature and specific humidity decrease
- (b) dry bulb temperature increases and specific humidity decreases
- (c) dry bulb temperature decreases and specific humidity increases
- (d) dry bulb temperature and specific humidity increase

10. Water at 42°C is sprayed into a stream of air at atmospheric pressure, dry bulb temperature of 40°C and a wet bulb temperature of 20°C. The air leaving the spray humidifier is not saturated.

Which of the following statements is true? [GATE-2005]

- (a) Air gets cooled and humidified
- (b) air gets heated and humidified
- (c) Air gets heated and dehumidified
- (d) Air gets cooled and dehumidified

11. For the following "Matching" exercise, choose the correct one from among the alternatives [GATE-2000]

A, B, C and D

Group 1

1. Marine Diesel Engine
2. Air conditioning
3. Steam Power Plant
4. Gas Turbine Power Plant

Group 2

- (A) Two stroke engine
- (B) Four stroke engine
- (C) Rotary engine
- (D) Cooling and dehumidification
- (E) Cooling tower
- (F) Brayton cycle
- (G) Rankine cycle
- (H) D - slide valve

- |     |     |     |     |
|-----|-----|-----|-----|
| (a) | (b) | (c) | (d) |
| 1-B | 1-C | 1-A | 1-A |
| 2-E | 2-F | 2-F | 2-D |
| 3-F | 3-E | 3-G | 3-G |
| 4-H | 4-G | 4-E | 4-F |

12. Air (at atmospheric pressure) at a dry bulb temperature of 40°C and wet bulb temperature of 20°C is humidified in an air washer operating with continuous water recirculation. The wet bulb depression (i.e. the difference between the dry and wet bulb temperatures) at the exit is 25% of that at the inlet. The dry bulb temperature at the exit of the air washer is closest to (A) 10°C (B) 20°C (C) 25°C (D) 30°C [GATE-2008]

13. Moist air at a pressure of 100 kPa is compressed to 500 kPa and then cooled to 35°C in an after cooler. The air at the entry to the after cooler is unsaturated and becomes just saturated at the exit of the after cooler. The saturation pressure of water at 35°C is 5.628 kPa. The partial pressure of water vapour (in kPa) in the moist air entering the compressor is closest to [GATE-2008]

- (A) 0.57 (B) 1.13 (C) 2.26 (D) 4.5

14. The statements concern Psychrometric chart. [GATE-2006]

1. Constant relative humidity lines are uphill straight lines to the right

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3. Constant specific volume lines are downhill straight lines to the right
4. Constant enthalpy lines are coincident with constant wet bulb temperature lines

Which of the statements are correct?

- (a) 2 and 3 (b) 1 and 2 (c) 1 and 3 (d) 2 and 4

15. Consider the following statements: [IES-1997]

- A psychrometer measures
1. wet bulb temperature
  2. dew point temperature
  3. dry bulb temperature.

On these statements

- (a) 1 alone is correct (b) 2 and 3 are correct (c) 1 and 3 are correct (d) 1, 2 and 3 are correct

16. If the specific heats of dry air and water vapour are 1.00 kJ/kg-K and 1.88 kJ/kg-K respectively and the humidity ratio is 0.011, then the specific heat of moist air at 25°C and 50% relative humidity will be [IES-1994]

- (a) 1.0207 kJ/kg-K (b) 1.869 kJ/kg-K (c) 1.891 kJ/kg-K (d) 0.9793 kJ/kg-K

17. If  $P_a$  and  $P_v$  denote respectively the partial pressure of dry air and that of water vapour in moist air, the specific humidity of air is given by

- (a)  $\frac{P_v}{P_v+P_a}$  (b)  $\frac{P_v}{P_a}$  (c)  $\frac{0.622 P_v}{P_a}$  (d)  $\frac{0.622 P_v}{P_a + P_v}$

18. The humidity ratio of atmospheric air at 28°C dbt and 760 mm of Hg is 0.016 kgv/kg-da. What is the partial pressure of water vapour? [IES-2009]

- (a) 2.242kN/m<sup>2</sup> (b) 2.535kN/m<sup>2</sup> (c) 3.535kN/m<sup>2</sup> (d) 4.242kN/m<sup>2</sup>

19. In a sample of moist air at standard atmospheric pressure of 101.325 kPa and 26°C the partial pressure of water vapour is 1.344 kPa. If the saturation pressure of water vapour is 3.36 kPa at 26°C, then what are the humidity ratio and relative humidity of moist air sample? [IES-2009]

- (a) 0.00836 and 1.32% (b) 0.00836 and 40% (c) 0.01344 and 1.32% (d) 0.01344 and 40%

20. The equation  $\phi \frac{P_v}{P_s} =$  is used to calculate the ( $p_v$  = partial pressure of water vapour in moist air at a given temperature,  $P_s$  = saturation pressure of water vapour at the same temperature) [IES-1999]

- (a) relative humidity (b) degree of saturation (c) specific humidity (d) absolute humidity

21. If the volume of moist air with 50% relative humidity is isothermally reduced to half its original volume, then relative humidity of moist air becomes [IES-2003]

- (a) 25 % (b) 60 % (c) 75 % (d) 100 %

22. The wet bulb depression is zero, when relative humidity is equal to [IES-2006]

- (a) 100% (b) 60% (c) 40% (d) Zero

23. Evaporative air-cooler is used effectively when [IES-1995]

- (a) dry bulb temperature is very close to the wet bulb temperature  
 (b) dry bulb temperature is high and relative humidity is high  
 (c) dry-bulb temperature is low and relative humidity is high  
 (d) dry bulb temperature is high and the relative humidity is low.

24. What is the saturation temperature at the partial pressure of water vapour in the air-water vapour mixture called? [IES-2009]

- (a) Dry bulb temperature (b) Web bulb temperature (c) Dew point temperature (d) Saturation temperature

25. In a cooling tower, the minimum temperature to which water can be cooled is equal to the [IES-1995; 2001]

- (a) dew point temperature of the air at the inlet (b) dry bulb temperature of the air at the inlet  
 (c) thermodynamic wet bulb temperature of the air at the inlet  
 (d) mean of the dew point and dry bulb temperature of the air at the inlet

26. In a chilled-water spray pond, the temperature of water is lower than dew point temperature of entering air. The air passing through the spray undergoes [IES-1999]

(a) cooling and humidification (b) cooling and dehumidification (c) sensible cooling (d) dehumidification

27. When a stream of moist air is passed over a cold and dry cooling coil such that no condensation takes place, then the air stream will get cooled along the line of [IES-1996]

(a) constant wet bulb temperature (b) constant dew point temperature  
(c) constant relative humidity (d) constant enthalpy

28. Air at state 1 (dpt  $10^{\circ}\text{C}$ ,  $W = 0.0040 \text{ kg/kgair}$ ) mixes with air at state 2 (dpt  $18^{\circ}\text{C}$ ,  $W = 0.0051 \text{ kg/kgair}$ ) in the ratio 1 to 3 by weight. The degree of saturation (%) of the mixture is (the specific humidity of saturated air at  $13.6^{\circ}\text{C}$ ,  $W = 0.01 \text{ kg/kgair}$ ) [IES-1999]

(a) 25 (b) 30 (c) 48 (d) 62

29. Match List I with List II and select the correct answer using the code given below the Lists: [IES-2005]

List I

List II

A Degree of saturation

1. Measure of latent enthalpy of moist air

B. Dry bulb temperature

2. Measure of total enthalpy of moist air

C. Wet bulb temperature

3. Measure of the capacity of air to absorb moisture

D. Dew point temperature

4. Measure of sensible enthalpy of moist air

A B C D

A B C D

(a) 2 1 3 4

(b) 3 4 2 1

(c) 2 4 3 1

(d) 3 1 2 4

30. Consider the following statements: [IES-2004]

1. The specific humidity is the ratio of the mass of water vapour to the mass of dry air in a given volume of the mixture

2. The relative humidity of the atmospheric air is the ratio of the actual mass of the water vapour in a given volume to that which it would have if it were saturated at the same temperature

3. The degree of saturation is defined as the ratio of the specific humidity of a mixture to the specific humidity of the mixture when saturated at the same temperature

Which of the statements given above are correct?

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

31. In a cooling tower the sum of range and approach is equal to twice the wet bulb depression. Then [IES-2003]

(a) Dry bulb temperature is mean of water inlet temperature and wet bulb temperature

(b) Dry bulb temperature is mean of water outlet temperature and wet bulb temperature

(c) Water inlet temperature is mean of dry bulb temperature and wet bulb temperature

(d) Water inlet temperature is mean of water outlet temperature and wet bulb temperature

32. In case A, moist air is adiabatically saturated and in case B, moist air is isobarically saturated. The saturation temperatures in cases A and B are respectively [IES-2002]

(a) dry bulb temperature and wet bulb temperature

(b) dew point temperature and wet bulb temperature

(c) wet bulb temperature and dew point temperature

(d) wet bulb temperature and dry bulb temperature

33. When the wet bulb and dry bulb temperatures are equal, which of the following statements is/are correct? [IES-2005]

1. Air is fully saturated. 2. Dew point temperature is reached.

3. Partial pressure of vapour equals to the total pressure. 4. Humidity ratio is 100%.

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

34. When the wet and dry bulb temperatures are identical, which of the following statements is/are true? [IES-2001; 2003]

1. Air is fully saturated 2. Dew point temperature is reached

3. Humidity ratio is unity 4. A Partial pressure of vapour equals total pressure

Select the correct answer from the codes given below:

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

35. When dry-bulb and wet-bulb temperatures are identical, it means that the

(a) air is fully saturated and dew-point temperature has reached [IES-2000]

(b) air is fully saturated

(c) dew-point temperature has reached and humidity is 100%

- (d) partial pressure of water vapour is equal to total pressure
36. At 100% relative humidity, the wet bulb temperature is [IES-1995]
- (a) more than dew point temperature (b) same as dew point temperature  
(c) less than dew point temperature (d) equal to ambient temperature.
37. In a saturated air-water vapour mixture, the [IES-1993]
- (a) dry bulb temperature is higher than the wet bulb temperature  
(b) dew point temperature is lower than the wet bulb temperature  
(c) dry bulb, wet bulb and dew point temperatures are the same  
(d) dry bulb temperature is higher than the dew point temperature
38. During adiabatic saturation process of air, wet bulb temperature [IES-1999]
- (a) increases and dry bulb temperature remains constant  
(b) remains constant and dry bulb temperature increases  
(c) remains constant and dry bulb temperature decreases  
(d) decreases and dry bulb temperature remains constant
39. During the adiabatic cooling of moist air [IES-1996]
- (a) DBT remains constant (b) specific humidity remains constant.

#### UNIT-6 Air Conditioning

1. Dew point temperature of air at one atmospheric pressure (1.013 bar) is 18°C. The air dry bulb temperature, is 30°C. The saturation pressure of water at 18°C and 30°C are 0.02062 bar and 0.04241 bar respectively. The specific heat of air and water vapour respectively are 1.005 and 1.88 kJ/kg K and the latent heat of vaporization of water at 0°C is 2500 kJ/kg. The specific humidity and enthalpy (kJ/kg of dry air) of this moist air respectively, are [GATE 2004]
- (a) 0.01051, 52.64 (b) 0.01291, 63.15 (c) 0.01481, 78.60 (d) 0.01532, 81.40
2. A moist air sample has dry bulb temperature of 30°C and specific humidity of 11.5 g water vapour per kg dry air. Assume molecular weight of air as 28.93. If the saturation vapour pressure of water at 30°C is 4.24 kPa and the total pressure is 90 kPa, then the relative humidity (in %) of air sample is
- (a) 50.5 (b) 38.5 (c) 56.5 (d) 68.5 [GATE-2010]
3. For a typical sample of ambient air (at 35 °C, 75% relative humidity and standard atmospheric pressure), the amount of moisture in kg per kg of dry air will be approximately [GATE-2005]
- (a) 0.002 (b) 0.027 (c) 0.25 (d) 0.75
4. For air at a given temperature, as the relative humidity is increased isothermally, [GATE-2001]
- (a) the wet bulb temperature and specific enthalpy increase  
(b) the wet bulb temperature and specific enthalpy decrease  
(c) the wet bulb temperature increases and specific enthalpy decreases  
(d) the wet bulb temperature decreases and specific enthalpy increases
5. Dew point temperature is the temperature at which condensation begins when the air is cooled at constant [GATE-2006]
- (a) volume (b) entropy (c) pressure (d) enthalpy
6. For air with a relative humidity of 80% [GATE-2003]
- (a) the dry bulb temperature is less than the wet bulb temperature  
(b) the dew point temperature is less than wet bulb temperature  
(c) the dew point and wet bulb temperatures are equal  
(d) the dry bulb and dew point temperatures are equal
7. The statements concern Psychrometric chart. [GATE-2006]
1. Constant relative humidity lines are uphill straight lines to the right
  2. Constant wet bulb temperature lines are downhill straight lines to the right
  3. Constant specific volume lines are downhill straight lines to the right
  4. Constant enthalpy lines are coincident with constant wet bulb temperature lines
- Which of the statements are correct?
- (a) 1 and 2 (b) 2 and 3 (c) 1 and 3 (d) 2 and 4
8. When atmospheric air is heated at constant pressure, then which one is not correct. [GATE-2000]
- (a) humidity ratio does not change (b) relative humidity increases

(c) dew point temperature does not change (d) wet bulb temperature increases

9. During chemical dehumidification process of air [GATE-2004]

- (a) dry bulb temperature and specific humidity decrease
- (b) dry bulb temperature increases and specific humidity decreases
- (c) dry bulb temperature decreases and specific humidity increases
- (d) dry bulb temperature and specific humidity increase

10. Water at 42°C is sprayed into a stream of air at atmospheric pressure, dry bulb temperature of 40°C and a wet bulb temperature of 20°C. The air leaving the spray humidifier is not saturated. Which of the following statements is true? [GATE-2005]

- (a) Air gets cooled and humidified (b) air gets heated and humidified
- (c) Air gets heated and dehumidified (d) Air gets cooled and dehumidified

11. For the following "Matching" exercise, choose the correct one from among the alternatives [GATE-2000]

A, B, C and D

Group 1

- 1. Marine Diesel Engine
- 2. Air conditioning
- 3. Steam Power Plant
- 4. Gas Turbine Power Plant

Group 2

- (A) Two stroke engine
- (B) Four stroke engine
- (C) Rotary engine
- (D) Cooling and dehumidification
- (E) Cooling tower
- (F) Brayton cycle
- (G) Rankine cycle
- (H) D - slide valve

- (a) 1-B 1-C 1-A 1-A
- 2-E 2-F 2-F 2-D
- 3-F 3-E 3-G 3-G
- 4-H 4-G 4-E 4-F

12. Air (at atmospheric pressure) at a dry bulb temperature of 40°C and wet bulb temperature of 20°C is humidified in an air washer operating with continuous water recirculation. The wet bulb depression (i.e. the difference between the dry and wet bulb temperatures) at the exit is 25% of that at the inlet. The dry bulb temperature at the exit of the air washer is closest to

(A) 10°C (B) 20°C (C) 25°C (D) 30°C [GATE-2008]

13. Moist air at a pressure of 100 kPa is compressed to 500 kPa and then cooled to 35°C in an after cooler. The air at the entry to the after cooler is unsaturated and becomes just saturated at the exit of the after cooler. The saturation pressure of water at 35°C is 5.628 kPa. The partial pressure of water vapour (in kPa) in the moist air entering the compressor is closest to [GATE-2008]

(B) 0.57 (B) 1.13 (C) 2.26 (D) 4.5

14. The statements concern Psychrometric chart. [GATE-2006]

- 1. Constant relative humidity lines are uphill straight lines to the right
- 2. Constant wet bulb temperature lines are downhill straight lines to the right
- 3. Constant specific volume lines are downhill straight lines to the right
- 4. Constant enthalpy lines are coincident with constant wet bulb temperature lines

Which of the statements are correct?

(b) 2 and 3 (b) 1 and 2 (c) 1 and 3 (d) 2 and 4

15. Consider the following statements: [IES-1997]

- A psychrometer measures 1. wet bulb temperature 2. dew point temperature
- 3. dry bulb temperature.

On these statements

(a) 1 alone is correct (b) 2 and 3 are correct (c) 1 and 3 are correct (d) 1, 2 and 3 are correct

16. If the specific heats of dry air and water vapour are 1.00 kJ/kg-K and 1.88 kJ/kg-K respectively and the humidity ratio is 0.011, then the specific heat of moist air at 25°C and 50% relative humidity will be [IES-1994]

(a) 1.0207 kJ/kg-K (b) 1.869 kJ/kg-K (c) 1.891 kJ/kg-K (d) 0.9793 kJ/kg-K

17. If  $P_a$  and  $P_v$  denote respectively the partial pressure of dry air and that of water vapour in moist air, the specific humidity of air is given by

- (a)  $\frac{P_v}{P_v+P_a}$       (b)  $\frac{P_v}{P_a}$       (c)  $\frac{0.622 P_v}{P_a}$       (d)  $\frac{0.622 P_v}{P_a+P_v}$

18. The humidity ratio of atmospheric air at 28°C dbt and 760 mm of Hg is 0.016 kgv/kg-da. What is the partial pressure of water vapour? [IES-2009]

- (a) 2.242kN/m<sup>2</sup> (b) 2.535kN/m<sup>2</sup> (c) 3.535kN/m<sup>2</sup> (d) 4.242kN/m<sup>2</sup>

19. In a sample of moist air at standard atmospheric pressure of 101.325 kPa and 26°C the partial pressure of water vapour is 1.344 kPa. If the saturation pressure of water vapour is 3.36 kPa at 26°C, then what are the humidity ratio and relative humidity of moist air sample? [IES-2009]

- (a) 0.00836 and 1.32% (b) 0.00836 and 40% (c) 0.01344 and 1.32% (d) 0.01344 and 40%

20. The equation  $\phi = \frac{P_v}{P_s}$  is used to calculate the ( $P_v$  = partial pressure of water vapour in moist air at a given temperature,  $P_s$  = saturation pressure of water vapour at the same temperature) [IES-1999]

- (a) relative humidity (b) degree of saturation (c) specific humidity (d) absolute humidity

21. If the volume of moist air with 50% relative humidity is isothermally reduced to half its original volume, then relative humidity of moist air becomes [IES-2003]

- (a) 25 % (b) 60 % (c) 75 % (d) 100 %

22. The wet bulb depression is zero, when relative humidity is equal to [IES-2006]

- (a) 100% (b) 60% (c) 40% (d) Zero

23. Evaporative air-cooler is used effectively when [IES-1995]

- (a) dry bulb temperature is very close to the wet bulb temperature  
 (b) dry bulb temperature is high and relative humidity is high  
 (c) dry-bulb temperature is low and relative humidity is high  
 (d) dry bulb temperature is high and the relative humidity is low.

24. What is the saturation temperature at the partial pressure of water vapour in the air-water vapour mixture called? [IES-2009]

- (a) Dry bulb temperature (b) Web bulb temperature (c) Dew point temperature (d) Saturation temperature

25. In a cooling tower, the minimum temperature to which water can be cooled is equal to the [IES-1995; 2001]

- (a) dew point temperature of the air at the inlet (b) dry bulb temperature of the air at the inlet  
 (c) thermodynamic wet bulb temperature of the air at the inlet  
 (d) mean of the dew point and dry bulb temperature of the air at the inlet

26. In a chilled-water spray pond, the temperature of water is lower than dew point temperature of entering air. The air passing through the spray undergoes [IES-1999]

- (a) cooling and humidification (b) cooling and dehumidification (c) sensible cooling (d) dehumidification

27. When a stream of moist air is passed over a cold and dry cooling coil such that no condensation takes place, then the air stream will get cooled along the line of [IES-1996]

- (a) constant web bulb temperature (b) constant dew point temperature  
 (c) constant relative humidity (d) constant enthalpy

28. Air at state 1 (dpt 10°C,  $W = 0.0040$  kg/kgair) mixes with air at state 2 (dpt=18°C,  $W = 0.0051$  kg/kgair) in the ratio 1 to 3 by weight. The degree of saturation (%) of the mixture is (the specific humidity of saturated air at 13.6°C,  $W = 0.01$  kg/kgair) [IES-1999]

- (a) 25 (b) 30 (c) 48 (d) 62

29. Match List I with List II and select the correct answer using the code given below the Lists: [IES-2005]

List I

- A Degree of saturation  
 B. Dry bulb temperature  
 C. Wet bulb temperature  
 D. Dew point temperature

List II

1. Measure of latent enthalpy of moist air  
 2. Measure of total enthalpy of moist air  
 3. Measure of the capacity of air to absorb moisture  
 4. Measure of sensible enthalpy of moist air

A B C D

A B C D

- (a) 2 1 3 4

- (b) 3 4 2 1

- (c) 2 4 3 1

- (d) 3 1 2 4



30. Consider the following statements: [IES-2004]

1. The specific humidity is the ratio of the mass of water vapour to the mass of dry air in a given volume of the mixture
2. The relative humidity of the atmospheric air is the ratio of the actual mass of the water vapour in a given volume to that which it would have if it were saturated at the same temperature
3. The degree of saturation is defined as the ratio of the specific humidity of a mixture to the specific humidity of the mixture when saturated at the same temperature

Which of the statements given above are correct?

- (a) 1 and 2 (b) 2 and 3 (c) 1 and 3 (d) 1, 2 and 3

31. In a cooling tower the sum of range and approach is equal to twice the wet bulb depression. Then [IES-2003]

- (a) Dry bulb temperature is mean of water inlet temperature and wet bulb temperature
- (b) Dry bulb temperature is mean of water outlet temperature and wet bulb temperature
- (c) Water inlet temperature is mean of dry bulb temperature and wet bulb temperature
- (d) Water inlet temperature is mean of water outlet temperature and wet bulb temperature

32. In case A, moist air is adiabatically saturated and in case B, moist air is isobarically saturated. The saturation temperatures in cases A and B are respectively [IES-2002]

- (a) dry bulb temperature and wet bulb temperature
- (b) dew point temperature and wet bulb temperature
- (c) wet bulb temperature and dew point temperature
- (d) wet bulb temperature and dry bulb temperature

33. When the wet bulb and dry bulb temperatures are equal, which of the following statements is/are correct? [IES-2005]

1. Air is fully saturated.
  2. Dew point temperature is reached.
  3. Partial pressure of vapour equals to the total pressure.
  4. Humidity ratio is 100%.
- (a) 1 and 2 (b) 1 only (c) 1, 2 and 4 (d) 2 and 3

34. When the wet and dry bulb temperatures are identical, which of the following statements is/are true? [IES-2001; 2003]

1. Air is fully saturated
2. Dew point temperature is reached
3. Humidity ratio is unity
4. A Partial pressure of vapour equals total pressure

Select the correct answer from the codes given below:

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

35. When dry-bulb and wet-bulb temperatures are identical, it means that the

- (a) air is fully saturated and dew-point temperature has reached [IES-2000]
- (b) air is fully saturated
- (c) dew-point temperature has reached and humidity is 100%
- (d) partial pressure of water vapour is equal to total pressure

36. At 100% relative humidity, the wet bulb temperature is [IES-1995]

- (a) more than dew point temperature (b) same as dew point temperature
- (c) less than dew point temperature (d) equal to ambient temperature.

37. In a saturated air-water vapour mixture, the [IES-1993]

- (a) dry bulb temperature is higher than the wet bulb temperature
- (b) dew point temperature is lower than the wet bulb temperature
- (c) dry bulb, wet bulb and dew point temperatures are the same
- (d) dry bulb temperature is higher than the dew point temperature

38. During adiabatic saturation process of air, wet bulb temperature [IES-1999]

- (a) increases and dry bulb temperature remains constant
- (b) remains constant and dry bulb temperature increases
- (c) remains constant and dry bulb temperature decreases
- (d) decreases and dry bulb temperature remains constant

39. During the adiabatic cooling of moist air [IES-1996]

- (a) DBT remains constant (b) specific humidity remains constant.
- (c) relative humidity remains constant (d) WBT remains constant.

1. Which of the following properties decrease(s) with sensible heating of air-water vapour mixture? [IES-2008]

1. Relative humidity
2. Humidity ratio
3. Specific enthalpy of air-vapour mixture

#### 4. Wet bulb temperature

Select the correct answer using the code given below:

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

2. Moist air is a mixture of dry air and water vapour. Hence three independent intrinsic thermodynamic properties are required to fix its thermodynamic state. While using Psychrometric chart, however, only two thermodynamic properties are needed since, Psychrometric chart [IES-1993]

- (a) is an approximation to actual properties  
(b) assumes that both water vapour and dry air behave like perfect gases  
(c) is drawn for actual properties of water vapour and dry air  
(d) is drawn for a fixed pressure

3. To fix the state point in respect of air-vapour mixtures, three intrinsic properties are needed. Yet, the Psychrometric chart requires only two because [IES-1998]

- (a) water vapour is in the superheated state  
(b) the chart is for a given pressure  
(c) the chart is an approximation to true values  
(d) the mixtures can be treated as a perfect gas

4. Which one of the following is correct? [IES-2008]

On Psychrometric chart, the constant wet bulb temperature lines coincide with.

- (a) constant relative humidity lines  
(b) constant enthalpy lines  
(c) constant dew point temperature lines  
(d) constant volume lines

5. Which of the following properties increases) during sensible heating of airwater vapour-mixture? [IES-2003]

1. Relative humidity 2. Humidity ratio 3. Wet bulb temperature 4. Specific enthalpy of air-vapour mixture

Select the correct answer from the codes given below:

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

6. Atmospheric air at 35°C and 60% RH can be brought to 20°C and 60% RH by:

- (a) Cooling and dehumidification process  
(b) Cooling and humidification process  
(c) Adiabatic saturation process  
(d) Sensible cooling process

7. Consider the following statements: [IES-1995]

In psychrometry, wet-bulb temperature is a measure of enthalpy of moist air, so that in the Psychrometric chart,

1. the constant enthalpy lines are also constant wet bulb temperature lines  
2. the wet bulb and dry bulb temperature are same at any condition  
3. the wet - bulb and dry-bulb temperature are equal at saturation condition.

Of these statements.

- (a) 1 alone is correct (b) 1 and 2 are correct  
(c) 1 and 3 are correct (d) 2 and 3 are correct.

8. Which one of the following statements is correct? [IES-1994]

- (a) Pressure and temperature are independent during phase change.  
(b) An isothermal line is also a constant pressure line in the wet vapour region.  
(c) Entropy decreases during evaporation.  
(d) The term dryness fraction is used to specify the fraction by mass of liquid in a mixture of liquid and vapour.

9. In a psychrometric chart, what does a vertical downward line represent?

- (a) Sensible cooling process (b) Adiabatic saturation process  
(c) Humidification process (d) Dehumidification process [IES-2009]

10. Consider the following statements: [IES-1994]

During sensible heating

1. moisture content increases 2. dry bulb temperature and wet bulb temperature increase

3. dew point remains constant 4. relative humidity increases

Select the correct answer using the codes given below:

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

11. Consider the following statements regarding Psychrometric processes:

1. Sensible heating is a process in which moisture content remains unchanged.

2. In the dehumidification process the dew point temperature remains same.

3. The process of adding moisture at constant dry bulb temperature is known as pure humidification process.

Which of the statements given above is/are correct? [IES-2008]

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

12. Which one of the following is correct? [IES-2008] In a sensible heating or cooling process

(a) dry bulb temperature remains constant (b) wet bulb temperature remains constant

(c) the humidity ratio remains constant (d) the relative humidity remains constant

13. For air-conditioning the operation theatre in a hospital, the percentage of outside air in the air supplied is [IAS-1995]

(a) zero (b) 20 (c) 50 (d) 100

14. Which of the following items related to infiltration of outdoor air in an airconditioning system, are correctly matched? [IAS-2007]

1. Stack effect : Height of building 2. Crack length method : Wind velocity

3. Air change method : Floor area 4. Door opening : Occupancy in kitchen

Select the correct answer using the code given below:

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

15. A room air is at a DBT of  $T_r$  and relative humidity  $\phi_r$ . The effective temperature of the room is [IAS 1994]

(a) the temperature at which the room air is saturated but gives the same feeling of comfort as the actual state of the room air

(b) the temperature at which the room air is at 50% relative humidity but gives the same feeling of comfort as the actual state of the room air

(c) the temperature at which the room air is completely dry but gives the same feeling of comfort as the actual state of the room air.

(d) none of the above.

16. Consider the following statements: [IAS-1996] Effective temperature

1. Is a measure of the sensation of warmth or coldness.

2. Is the uniform temperature of an imaginary enclosure with which man will exchange the same dry heat by radiation and convection as in the actual environment.

3. Combines the effects of dry bulb temperature, wet bulb temperature and air movement.

Of these statements:

(a) 1 and 2 are correct (b) 1 and 2 are correct

(c) 2 and 3 are correct (d) 1 and 3 are correct

17. Which one of the following statements is true for effective temperature, ET? [IAS-2004]

(a) ET increases with increase in level of activity and it decreases with increase in air velocity

(b) ET decreases with increase in level of activity and it increases with increase in air velocity.

(c) ET increases with increase in level of activity and it increases with increase in air velocity

(d) ET decreases with increase in level of activity and decreases with increase in air velocity.

18. Consider the following statements: [IAS-1999]

Effective temperature is NOT a true comfort index because

1. discomfort may be experienced at extremely high or low humidities.

2. the radiation effect of surrounding surfaces has not been taken into account.

3. it presumes the absence of drafts. Of these statements:

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct (c) 1 and 3 are correct (d) 2 and 3 are correct

19. In room air-conditioning for comfort, the supply air in summer should be at [IAS-1997]

(a) the same temperature as that of the room (b) 5 to 10° C below the room temperature

(c) 2 to 30C above the room temperature (d) at 0° C

20. The difference between the comfort air conditioning and industrial air conditioning lies in the [IAS-1998]

- (a) equipment used (b) process adopted
- (c) indoor requirements (d) ambient conditions.

21. Instantaneous cooling loads are NOT equal to instantaneous heat gains because [IES-2003]

- (a) Heat gains are offset by cooling provided by the AC system (b) Indoor temperatures are lower
- (c) Comfort conditions are maintained in the space
- (d) Of the storage effect in the construction material of walls and roof

22. Assertion (A): In an air-conditioned room, the reflective coating should be on the inside of the window.

Reason (R): plane Window glass is transparent to solar radiation. [IES-1996]

- (a) Both A and R are individually true and R is the correct explanation of A
- (b) Both A and R are individually true but R is not the correct explanation of A
- (c) A is true but R is false (d) A is false but R is true

23. On which of the following factors does sol-air temperature depend? [IES-2003]

- 1. Outdoor air temperature 2. Intensity of solar radiation 3. Absorptivity of wall
- 4. Convective heat transfer coefficient at outer surface of wall 5. Indoor design temperature

Choose the correct answer from the codes given below:

- (a) 1, 2 and 5 (b) 1, 2 and 3 (c) 3 and 4 (d) 1, 2, 3 and 4

24. Consider the following factors: [IES-1994]

- 1. Wind velocity 2. Type of activity 3. Indoor design conditions 4. Door openings

Occupancy load in cooling load calculations depends upon

- (a) 1 and 2 (b) 1 and 3 (c) 1 and 4 (d) 2 and 3.

25. In air-conditioning design for summer months, the condition inside a factory where heavy work is performed as compared to a factory in which light work is performed should have [IES-1998]

- (a) lower dry bulb temperature and lower relative humidity
- (b) lower dry bulb temperature and higher relative humidity
- (c) lower dry bulb temperature and same relative humidity
- (d) same dry bulb temperature and same relative humidity

26. Two summer air-conditioning systems with non-zero by pass factor are proposed for a room with a known sensible and latent heat load. System A operates with ventilation but system B operates without ventilation. Then the [IES-1995]

- a) bypass factor of system A must be less than the bypass factor of system B
- (b) bypass factor of system A must be more than the bypass factor of system B
- (c) apparatus dew point for system A must be lower than the apparatus dew point for system B
- (d) apparatus dew point for system A must be higher than the apparatus dew point for system B.