

- (A)  $PV$
- (B)  $2PV$
- (C)  $PV/2$
- (D) 0

Answer: Option A

**03. Pick out the wrong statement.**

- (A) An ideal liquid or solid solution is defined as one in which each component obeys Raoult's law
- (B) If Raoult's law is applied to one component of a binary mixture; Henry's law or Raoult's law is applied to the other component also
- (C) Henry's law is rigorously correct in the limit of infinite dilution
- (D) None of these

Answer: Option D

**04. Which of the following is an undesirable characteristic of a refrigerant?**

- (A) It should be non-explosive
- (B) It should have a sub-atmospheric vapor pressure at the temperature in refrigerator coils
- (C) Its vapor pressure at the condenser temperature should be very high
- (D) None of these

Answer: Option B

**05. Work done may be calculated by the expression  $\int p \, dA$  for \_\_\_\_\_ processes.**

- (A) Non-flow reversible
- (B) Adiabatic
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

**06. Sound waves propagation in air exemplifies an \_\_\_\_\_ process.**

- (A) Adiabatic
- (B) Isothermal
- (C) Isometric
- (D) None of these

Answer: Option A

**07. Pick out the correct statement.**

- (A) Like internal energy and enthalpy, the absolute value of standard entropy for elementary substances is zero
- (B) Melting of ice involves increase in enthalpy and a decrease in randomness
- (C) The internal energy of an ideal gas depends only on its pressure
- (D) Maximum work is done under reversible conditions

Answer: Option D

**08.  $1\text{m}^3$  of an ideal gas at 500 K and 1000 kPa expands reversibly to 5 times its initial volume in an insulated container. If the specific heat capacity (at constant pressure) of the gas is 21 J/mole . K, the final temperature will be**

- (A) 35 K
- (B) 174 K
- (C) 274 K

(D) 154 K  
Answer: Option C

**09. Pick out the correct statement.**

- (A) Entropy and enthalpy are path functions
  - (B) In a closed system, the energy can be exchanged with the surrounding, while matter cannot be exchanged
  - (C) All the natural processes are reversible in nature
  - (D) Work is a state function
- Answer: Option C

**10. In the reaction;  $N_2 + O_2 \rightleftharpoons 2NO$ , increasing the pressure will result in**

- (A) Shifting the equilibrium towards right
  - (B) Shifting the equilibrium towards left
  - (C) No change in equilibrium condition
  - (D) None of these
- Answer: Option C

**11. \_\_\_\_\_ does not change during phase transformation processes like sublimation, melting & vaporisation.**

- (A) Entropy
  - (B) Gibbs free energy
  - (C) Internal energy
  - (D) All (A), (B) & (C)
- Answer: Option B

**12. At a given temperature, the volume of a gas dissolved in a solvent \_\_\_\_\_ with increase in pressure.**

- (A) Increases
  - (B) Decreases
  - (C) Remains unchanged
  - (D) May increase or decrease; depends on the gas
- Answer: Option C

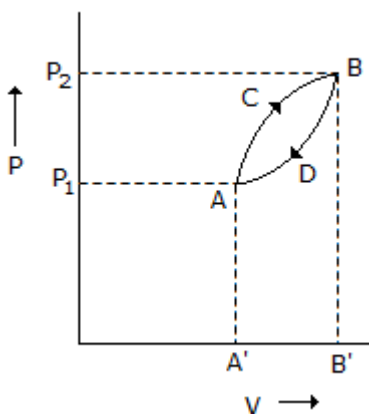
**13. At constant temperature and pressure, for one mole of a pure substance, the ratio of the free energy to the chemical potential is**

- (A) Zero
  - (B) One
  - (C) Infinity
  - (D) Negative
- Answer: Option B

**14. Lenz's law results from the law of conservation of**

- (A) Mass
  - (B) Momentum
  - (C) Energy
  - (D) None of these
- Answer: Option C

**15. A thermodynamic system is taken from state A to B along ACB and is brought back to A along BDA as shown below in the P-V diagram. The net work done during the complete cycle is given by the area covered by**



- (A)  $P_1ACBP_2P_1$
- (B)  $ACBB^1A^1A$
- (C)  $ACBDA$
- (D)  $ADBB^1A^1A$

Answer: Option C

**16. Which of the following units is not present in both the vapor compression refrigeration system and absorption refrigeration system?**

- (A) Expansion valve
- (B) Condenser
- (C) Refrigerator
- (D) Compressor

Answer: Option D

**17. One ton of refrigeration capacity is equivalent to the heat removal rate of**

- (A) 50 kcal/hr
- (B) 200 BTU/hr
- (C) 200 BTU/minute
- (D) 200 BTU/day

Answer: Option C

**18. The equation relating  $E$ ,  $P$ ,  $V$  and  $T$  which is true for all substances under all conditions is given by  $(\partial E/\partial V)_T = T(\partial P/\partial T)_H - P$ . This equation is called the**

- (A) Maxwell's equation
- (B) Thermodynamic equation of state
- (C) Equation of state
- (D) Redlich-Kwong equation of state

Answer: Option B

**19. Entropy, which is a measure of the disorder of a system, is:**

- (A) Independent of pressure
- (B) Independent of temperature
- (C) Zero at absolute zero temperature for a perfect crystalline substance
- (D) All (A), (B) & (C)

Answer: Option C

**20. A refrigerator works on the principle of \_\_\_\_\_ law of thermodynamics.**

- (A) Zeroth
- (B) First
- (C) Second
- (D) Third

Answer: Option C

**21.  $C_v$  is given by**

- (A)  $(\partial E/\partial T)_V$
- (B)  $(\partial E/\partial V)_T$
- (C)  $(\partial E/\partial P)_V$
- (D)  $(\partial V/\partial T)_P$

Answer: Option A

**22. Gibbs free energy ( $G$ ) is represented by,  $G = H - TS$ , whereas Helmholtz free energy, ( $A$ ) is given by,  $A = E - TS$ . Which of the following is the Gibbs-Helmholtz equation?**

- (A)  $[\partial(G/T)/\partial T] = - (H/T^2)$
- (B)  $[\partial(A/T)/\partial T]_V = - E/T^2$
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

**23. There is a change in \_\_\_\_\_ during the phase transition.**

- (A) Volume
- (B) Pressure
- (C) Temperature
- (D) All a, b & c

Answer: Option A

**24. In Joule-Thomson porous plug experiment, the**

- (A) Enthalpy does not remain constant
- (B) Entire apparatus is exposed to surroundings
- (C) Temperature remains constant
- (D) None of these

Answer: Option D

**25. Forward reaction will be favoured for the exothermic reaction, represented by**

**$\text{CO} + \text{H}_2\text{O} \rightleftharpoons \text{CO}_2 + \text{H}_2$ , by**

- (A) Low temperature and high pressure
- (B) Low temperature and low pressure
- (C) High temperature and high pressure
- (D) High temperature and low pressure

Answer: Option A

**26. A gas mixture of three components is brought in contact with a dispersion of an organic phase in water. The degree of freedom of the system is**

- (A) 3
- (B) 4
- (C) 5
- (D) 6

Answer: Option A

**27. If two gases have same reduced temperature and reduced pressure, then they will have the same**

- (A) Volume
- (B) Mass
- (C) Critical temperature
- (D) None of these

Answer: Option D

**28. A cyclic engine exchanges heat with two reservoirs maintained at 100 and 300°C respectively. The maximum work (in J) that can be obtained from 1000 J of heat extracted from the hot reservoir is**

- (A) 349
- (B) 651
- (C) 667
- (D) 1000

Answer: Option A

**29. "The fugacity of a gas in a mixture is equal to the product of its mole fraction and its fugacity in the pure state at the total pressure of the mixture". This is**

- (A) The statement as per Gibbs-Helmholtz
- (B) Called Lewis-Randall rule
- (C) Henry's law
- (D) None of these

Answer: Option B

**30. Chemical potential (an intensive property) of a substance is a force that drives the chemical system to equilibrium and is equal to its partial molar properties. The ratio of chemical potential to free energy of a pure substance at constant temperature and pressure is**

- (A) 0
- (B) 1
- (C)  $\infty$
- (D) None of these

Answer: Option B

**31. The internal energy of an ideal gas is a function of its \_\_\_\_\_ only.**

- (A) Molecular size
- (B) Volume
- (C) Pressure
- (D) Temperature

Answer: Option D

**32. One mole of nitrogen at 8 bar and 600 K is contained in a piston-cylinder arrangement. It is brought to 1 bar isothermally against a resisting pressure of 1 bar. The work done (in Joules) by the gas is**

- (A) 30554
- (B) 10373
- (C) 4988.4
- (D) 4364.9

Answer: Option B

**33. Third law of thermodynamics is helpful in**

- (A) Prediction of the extent of a chemical reaction
- (B) Calculating absolute entropies of substances at different temperature
- (C) Evaluating entropy changes of chemical reaction
- (D) Both (B) and (C)

Answer: Option D

**34. Trouton's ratio of \_\_\_\_\_ liquids is calculated using Kistyakowsky equation.**

- (A) Polar
- (B) Non-polar
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option B

**35. Entropy change for an irreversible process taking system and surrounding together is**

- (A) 0
- (B)  $> 0$
- (C)  $< 0$
- (D) None of these

Answer: Option B

**36. The shape of  $T$ - $S$  diagram for Carnot Cycle is a**

- (A) Rectangle
- (B) Rhombus
- (C) Trapezoid
- (D) Circle

Answer: Option A

**37. \_\_\_\_\_ explains the equilibrium constant for any chemical reaction.**

- (A) Henry's law
- (B) Law of mass action
- (C) Hess's law
- (D) None of these

Answer: Option B

**38. Claude's liquefaction process employs the cooling of gases by**

- (A) Expansion in an engine
- (B) Following a constant pressure cycle
- (C) Throttling
- (D) None of these

Answer: Option A

**39. "When a system in equilibrium is subjected to a change in temperature, pressure or concentration, the equilibrium is displaced in a direction which tends to undo the effect of the change." This is called the**

- (A) Le-Chatelier principle
- (B) Kopp's rule
- (C) Law of corresponding state
- (D) Arrhenius hypothesis

Answer: Option A

**40. "The rate at which a substance reacts is proportional to its active mass and the rate of a chemical reaction is proportional to the product of active masses of the reacting substances". This is the**

- (A) Lewis-Randall rule
- (B) Statement of Van't Hoff Equation

(C) Le-Chatelier's principle

(D) None of these

Answer: Option D

**41. The adiabatic throttling process of a perfect gas is one of constant enthalpy**

(A) In which there is a temperature drop

(B) Which is exemplified by a non-steady flow expansion

(C) Which can be performed in a pipe with a constriction

(D) In which there is an increase in temperature

Answer: Option C

**42. A Carnot cycle consists of the following steps:**

(A) Two isothermal and two isentropic

(B) Two isobaric and two isothermal

(C) Two isochoric and two isobaric

(D) Two isothermals and two isochoric

Answer: Option A

**43. An isolated system can exchange \_\_\_\_\_ with its surroundings.**

(A) Matter

(B) Energy

(C) Neither matter nor energy

(D) Both matter and energy

Answer: Option C

**44. A solid is transformed into vapour without going to the liquid phase at**

(A) Triple point

(B) Boiling point

(C) Below triple point

(D) Always

Answer: Option A

**45. The compressibility factor for an ideal gas is 1. Its value for any other real gas is**

(A) 1

(B)  $< 1$

(C)  $> 1$

(D) Either (B) or (C), depends on the nature of the gas

Answer: Option D

**46. When a gas is subjected to adiabatic expansion, it gets cooled due to**

(A) Decrease in velocity

(B) Decrease in temperature

(C) Decrease in kinetic energy

(D) Energy spent in doing work

Answer: Option D

**47. Choose the condition that must be specified in order to liquify  $\text{CO}_2$  (triple point for  $\text{CO}_2$  is  $-57^\circ\text{C}$  and  $5.2\text{ atm}$ ).**

(A) Pressure must be kept below  $5.2\text{ atm}$

(B) Temperature must be kept above  $-57^\circ\text{C}$

(C) Pressure must be kept below  $5.2\text{ atm}$ . and temperature must be kept above  $57^\circ\text{C}$

(D) Pressure and temperature must be kept below  $5.2\text{ atm}$ . and  $-57^\circ\text{C}$  respectively

Answer: Option D

**48. Work done in case of free expansion is**

(A) Indeterminate

(B) Zero

(C) Negative

(D) None of these

Answer: Option B

**49. The change in \_\_\_\_\_ is equal to the reversible work for compression in steady state flow process under isothermal condition.**

(A) Internal energy

(B) Enthalpy

- (C) Gibbs free energy
  - (D) Helmholtz free energy
- Answer: Option C

**50. Ideal gas law is applicable at**

- (A) Low T, low P
  - (B) High T, high P
  - (C) Low T, high P
  - (D) High T, low P
- Answer: Option D

**51. Gibbs free energy ( $F$ ) is defined as**

- (A)  $F = E - TS$
- (B)  $F = H - TS$
- (C)  $F = H + TS$
- (D)  $F = E + TS$

Answer: Option B

**52. For an isothermal process, the internal energy of a gas**

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) Data insufficient, can't be predicted

Answer: Option C

**53. A refrigeration cycle is the same as a \_\_\_\_\_ cycle,**

- (A) Turbine
- (B) Heat engine
- (C) Reversed heat engine
- (D) None of these

Answer: Option C

**54. The molar excess Gibbs free energy,  $g^E$ , for a binary liquid mixture at  $T$  and  $P$  is given by,  $(g^E/RT) = A \cdot x_1 \cdot x_2$ , where  $A$  is a constant. The corresponding equation for  $\ln y_1$ , where  $y_1$  is the activity co-efficient of component 1, is**

- (A)  $A \cdot x_2^2$
- (B)  $Ax_1$
- (C)  $Ax_2$
- (D)  $Ax_1^2$

Answer: Option A

**55. The partial molar enthalpy of a component in an ideal binary gas mixture of composition  $Z$ , at a temperature  $T$  and pressure  $P$ , is a function only of**

- (A)  $T$
- (B)  $T$  and  $P$
- (C)  $T$ ,  $P$  and  $Z$
- (D)  $T$  and  $Z$

Answer: Option B

**56. The standard Gibbs free energy change of a reaction depends on the equilibrium**

- (A) Pressure
- (B) Temperature
- (C) Composition
- (D) All (A), (B) and (C)

Answer: Option B

**57. A solute distributes itself between two non-miscible solvents in contact with each other in such a way that, at a constant temperature, the ratio of its concentrations in two layers is constant, irrespective of its total amount". This is**

- (A) The distribution law
- (B) Followed from Margules equation
- (C) A corollary of Henry's law
- (D) None of these

Answer: Option A

**58. The most important application of distribution law is in**

- (A) Evaporation
- (B) Liquid extraction
- (C) Drying
- (D) Distillation

Answer: Option B

**59. Pick out the wrong statement**

- (A) Phase rule variables are intensive properties
- (B) Heat and work are both state function
- (C) The work done by expansion of a gas in vacuum is zero
- (D)  $C_p$  and  $C_v$  are state function

Answer: Option B

**60. Enthalpy changes over a constant pressure path are always zero for \_\_\_\_\_ gas.**

- (A) Any
- (B) A perfect
- (C) An easily liquefiable
- (D) A real

Answer: Option B

**61. Efficiency of a Carnot engine working between temperatures  $T_1$  and  $T_2$  ( $T_1 < T_2$ ) is**

- (A)  $(T_2 - T_1)/T_2$
- (B)  $(T_2 - T_1)/T_1$
- (C)  $(T_1 - T_2)/T_2$
- (D)  $(T_1 - T_2)/T_1$

Answer: Option A

**62. Fugacity is most helpful in**

- (A) Representing actual behaviour of real gases
- (B) Representing actual behaviour of ideal gases
- (C) The study of chemical equilibria involving gases at atmospheric pressure
- (D) None of these

Answer: Option A

**63. Chemical potential of  $i$ th component of a system is given by**

- (A)  $\mu_i = (\partial F/\partial n_i)_{T, P, n_i}$
- (B)  $\mu_i = (\partial A/\partial n_i)_{T, P, n_i}$
- (C)  $\mu_i = (\partial F/\partial n_i)_{T, P}$
- (D)  $\mu_i = (\partial A/\partial n_i)_{T, P}$

Answer: Option A

**64. During adiabatic expansion of gas**

- (A) Pressure remains constant
- (B) Pressure is increased
- (C) Temperature remains constant
- (D) None of these

Answer: Option D

**65. Kopp's rule is used to calculate the heat capacity of**

- (A) Solids
- (B) Liquids
- (C) Gases
- (D) All (A), (B) & (C)

Answer: Option A

**66. What is the degree of freedom for a system comprising liquid water equilibrium with its vapour?**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option B

**67. Heat of formation of an element in its standard state is**



- (A) 0
  - (B)  $< 0$
  - (C)  $> 0$
  - (D) A function of pressure
- Answer: Option A

**68. In an ideal solution, the activity of a component equals its**

- (A) Mole fraction
  - (B) Fugacity at the same temperature and pressure
  - (C) Partial pressure
  - (D) None of these
- Answer: Option A

**69. Pick out the wrong statement.**

- (A) The conversion for a gas phase reaction increases with decrease in pressure, if there is an increase in volume accompanying the reaction
- (B) With increase in temperature, the equilibrium constant increases for an exothermic reaction
- (C) The equilibrium constant of a reaction depends upon temperature only
- (D) The conversion for a gas phase reaction increases with increase in pressure, if there is a decrease in volume accompanying the reaction

Answer: Option B

**70. Which of the following non-flow reversible compression processes require maximum work?**

- (A) Adiabatic process
- (B) Isothermal process
- (C) Isobaric process
- (D) All require same work

Answer: Option A

**71. Enthalpy of a gas depends upon its**

- (A) Temperature
- (B) Mass
- (C) Volume
- (D) Pressure

Answer: Option A

**72. Pressure-enthalpy chart is useful in refrigeration. The change in internal energy of an ideal fluid used in ideal refrigeration cycle is**

- (A) Positive
- (B) Negative
- (C) Zero
- (D) Infinity

Answer: Option C

**73. The intensive properties are**

- (A) Molar volume, density, viscosity and boiling point
- (B) Refractive index and surface tension
- (C) Both (A) and (B)
- (D) None of these

Answer: Option C

**74. Which of the following is Clausius-Clapeyron Equation for vaporisation of an ideal gas under the condition that the molar volume of liquid is negligible compared to that of the vapor?**

- (A)  $d \ln p/dt = H_{\text{vap}}/RT^2$
- (B)  $d \ln p/dt = RT^2/H_{\text{vap}}$
- (C)  $dp/dt = RT^2/H_{\text{vap}}$
- (D)  $dp/dt = H_{\text{vap}}/RT^2$

Answer: Option A

**75. Standard temperature and pressure (S.T.P.) is**

- (A)  $0^\circ\text{C}$  and 750 mm Hg
- (B)  $15^\circ\text{C}$  and 750 mm Hg
- (C)  $0^\circ\text{C}$  and  $1 \text{ kgf/cm}^2$
- (D)  $15^\circ\text{C}$  and  $1 \text{ kgf/cm}^2$

Answer: Option A

76.  $C_p - C_v = R$  is valid for \_\_\_\_\_ gases.

- (A) Ideal
- (B) Very high pressure
- (C) Very low temperature
- (D) All of the above

Answer: Option A

77. The number of degree of freedom for an Azeotropic mixture of ethanol and water in vapour-liquid equilibrium, is

- (A) 3
- (B) 1
- (C) 2
- (D) 0

Answer: Option B

78. If two pure liquid constituents are mixed in any proportion to give an ideal solution, there is no change in

- (A) Volume
- (B) Enthalpy
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

79. Melting of wax is accompanied with \_\_\_\_\_ in entropy.

- (A) Increase
- (B) Decrease
- (C) No change
- (D) None of these

Answer: Option A

80. Activity co-efficient is a measure of the

- (A) Departure from ideal solution behaviour
- (B) Departure of gas phase from ideal gas law
- (C) Vapour pressure of liquid
- (D) None of these

Answer: Option A

81. Reduced pressure of a gas is the ratio of its

- (A) Pressure to critical pressure
- (B) Critical pressure to pressure
- (C) Pressure to pseudocritical pressure
- (D) Pseudocritical pressure to pressure

Answer: Option A

82. Fugacity and pressure are numerically equal, when the gas is

- (A) In standard state
- (B) At high pressure
- (C) At low temperature
- (D) In ideal state

Answer: Option D

83. Which of the following exemplifies an adiabatic process?

- (A) Melting of ice
- (B) Condensation of alcohol vapor
- (C) Sudden bursting of a cycle tube
- (D) Evaporation of water

Answer: Option C

84. Third law of thermodynamics is concerned with the

- (A) Value of absolute entropy
- (B) Energy transfer
- (C) Direction of energy transfer
- (D) None of these

Answer: Option A

**85. For the gaseous phase chemical reaction,  $C_2H_4(g) + H_2O(g) \leftrightarrow C_2H_5OH(g)$ , the equilibrium conversion does not depend on the**

- (A) Steam to ethylene ratio
- (B) Temperature
- (C) Pressure
- (D) None of these

Answer: Option D

**86. Clapeyron Equation deals with the**

- (A) Rate of change of vapour pressure with temperature
- (B) Effect of an inert gas on vapour pressure
- (C) Calculation of  $\Delta F$  for spontaneous phase change
- (D) Temperature dependence of heat of phase transition

Answer: Option A

**87. Which of the following is affected by the temperature?**

- (A) Fugacity
- (B) Activity co-efficient
- (C) Free energy
- (D) All (A), (B) & (C)

Answer: Option D

**88. For an ideal gas, the enthalpy**

- (A) Increases with rise in pressure
- (B) Decreases with rise in pressure
- (C) Is independent of pressure
- (D) Is a path function

Answer: Option C

**89. Chemical engineering thermodynamics is concerned with the \_\_\_\_\_ in/of chemical processes.**

- (A) Reaction mechanism
- (B) Calculation of rates
- (C) Energy transformation from one form to another
- (D) None of these

Answer: Option C

**90. Fugacity and pressure are numerically not equal for the gases**

- (A) At low temperature and high pressure
- (B) At standard state
- (C) Both (A) and (B)
- (D) In ideal state

Answer: Option C

**91. In vapour compression refrigeration system, if the evaporator temperature and the condenser temperatures are  $-13^\circ\text{C}$  and  $37^\circ\text{C}$  respectively, the Carnot COP will be**

- (A) 5.2
- (B) 6.2
- (C) 0.168
- (D) Data insufficient, can't be found out

Answer: Option A

**92. Work done in an adiabatic process between two states depends on the**

- (A) Rate of heat transmission
- (B) Initial state only
- (C) End states only
- (D) None of these

Answer: Option C

**93. Which one is true for a throttling process?**

- (A) A gas may have more than one inversion temperatures
- (B) The inversion temperature is different for different gases
- (C) The inversion temperature is same for all gases
- (D) The inversion temperature is the temperature at which Joule-Thomson co-efficient is infinity

Answer: Option B

**94. Which is an example of closed system?**

- (A) Air compressor
- (B) Liquid cooling system of an automobile
- (C) Boiler
- (D) None of these

Answer: Option B

**95. While dissolving a gas into a liquid at a constant temperature, the ratio of the concentration of the gas in the solution phase and in the gaseous phase is**

- (A) Infinity
- (B) Unity
- (C) Constant
- (D) Negative

Answer: Option C

**96. For a reversible process involving only pressure-volume work**

- (A)  $(dF)_T, p < 0$
- (B)  $(dF)_T, p > 0$
- (C)  $(dF)_T, p = 0$
- (D)  $(dA)_T, v < 0$

Answer: Option C

**97. Refrigerants commonly used for domestic refrigerators are**

- (A) Ethyl chloride or methyl chloride
- (B) Freon-12
- (C) Propane
- (D)  $\text{NH}_3$  or  $\text{CO}_2$

Answer: Option A

**98. Gibbs-Duhem equation relates composition in liquid phase and the \_\_\_\_\_ at constant temperature & pressure.**

- (A) Fugacity
- (B) Partial pressure
- (C) Activity co-efficient
- (D) All (A), (B), and (C)

Answer: Option D

**99. Pick out the wrong statement.**

- (A) Enthalpies of all elements in their standard states are assumed to be zero
- (B) Combustion reactions are never endothermic in nature
- (C) Heat of reaction at constant volume is equal to the change in internal energy
- (D) Clausius-Clapeyron equation is not applicable to melting process

Answer: Option D

**100. Pick out the correct statement.**

- (A) A real gas on expansion in vacuum gets heated up
- (B) An ideal gas on expansion in vacuum gets cooled
- (C) An ideal gas on expansion in vacuum gets heated up
- (D) A real gas on expansion in vacuum cools down whereas ideal gas remains unaffected

Answer: Option D

**101. Which of the following is not an extensive property?**

- (A) Free energy
- (B) Entropy
- (C) Refractive index
- (D) None of these

Answer: Option C

**102. A reasonably general expression for vapour-liquid phase equilibrium at low to moderate pressure is  $\phi_i y_i P = Y_i x_i f_i^\circ$  where,  $\Phi$  is a vapor fugacity component,  $Y_i$  is the liquid activity coefficient and  $f_i^\circ$  is the fugacity of the pure component i. the  $K_i$  value ( $Y_i = K_i x_i$ ) is therefore, in general a function of**

- (A) Temperature only

- (B) Temperature and pressure only
  - (C) Temperature, pressure and liquid composition  $x_i$  only
  - (D) Temperature, pressure, liquid composition  $x_i$  and vapour composition  $y_i$
- Answer: Option C

**103. Air-refrigeration cycle**

- (A) Is the most efficient of all refrigeration cycles
  - (B) Has very low efficiency
  - (C) Requires relatively large quantities of air to achieve a significant amount of refrigeration
  - (D) Both (B) and (C)
- Answer: Option D

**104. Pick out the wrong statement.**

- (A) Trouton's ratio of non-polar liquids is calculated using Kistyakowsky equation
  - (B) Thermal efficiency of a Carnot engine is always less than 1
  - (C) An equation relating pressure, volume and temperature of a gas is called ideal gas equation
  - (D) None of these
- Answer: Option C

**105. The minimum number of phases that can exist in a system is**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option B

**106. The reaction  $A(l) \rightarrow R(g)$  is allowed to reach equilibrium conditions in an autoclave. At equilibrium, there are two phases, one a pure liquid phase of A and the other a vapor phase of A, R and S. Initially A alone is present. The numbers of degrees of freedom are:**

- (A) 1
- (B) 2
- (C) 3
- (D) 0

Answer: Option B

**107. For an isothermal reversible compression of an ideal gas**

- (A) Only  $\Delta E = 0$
- (B) Only  $\Delta H = 0$
- (C)  $\Delta E = \Delta H = 0$
- (D)  $dQ = dE$

Answer: Option C

**108. Air enters an adiabatic compressor at 300K. The exit temperature for a compression ratio of 3, assuming air to be an ideal gas ( $\gamma = C_p/C_v = 7/5$ ) and the process to be reversible, is**

- (A)  $300 \times (3^{2/7})$
- (B)  $300 \times (3^{3/5})$
- (C)  $300 \times (33^{3/7})$
- (D)  $300 \times (3^{5/7})$

Answer: Option A

**109. Solid and liquid phases of a substance are in equilibrium at the**

- (A) Critical temperature
- (B) Melting point
- (C) Freezing point
- (D) Both (B) and (C)

Answer: Option D

**110. What is the ratio of adiabatic compressibility to isothermal compressibility?**

- (A) 1
- (B)  $< 1$
- (C)  $> 1$
- (D)  $\gg 1$

Answer: Option B

**111. Internal energy of an ideal gas**

- (A) Increases with increase in pressure
- (B) Decreases with increase in temperature
- (C) Is independent of temperature
- (D) None of these

Answer: Option D

**112. "Dry ice" is**

- (A) Moisture free ice
- (B) Solid helium
- (C) Solid carbon dioxide
- (D) None of these

Answer: Option C

**113. Requisites of a reversible process is that the**

- (A) System and surroundings pressure be equal
- (B) Friction in the system should be absent
- (C) System and surroundings temperature be equal
- (D) None of these

Answer: Option B

**114. Henry's law is closely obeyed by a gas, when its \_\_\_\_\_ is extremely high.**

- (A) Pressure
- (B) Solubility
- (C) Temperature
- (D) None of these

Answer: Option D

**115. The root mean square speed of molecules of a gas is equal to (where,  $m$  = mass of the molecule  $K$  = Boltzmann's constant,  $T$  = absolute temperature)**

- (A)  $\sqrt{(2KT/m)}$
- (B)  $\sqrt{(3KT/m)}$
- (C)  $\sqrt{(6KT/m)}$
- (D)  $3KT/m$

Answer: Option B

**116. In the equation,  $PV^n = \text{Constant}$ , if the value of  $n = 0$ , then it represents a reversible \_\_\_\_\_ process.**

- (A) Isobaric
- (B) Isothermal
- (C) Isentropic
- (D) Isometric

Answer: Option A

**117. Normal temperature and pressure (N.T.P.) corresponds to**

- (A)  $0^\circ\text{C}$  and 760 mm Hg
- (B)  $15^\circ\text{C}$  and 760 mm Hg
- (C)  $20^\circ\text{C}$  and 760 mm Hg
- (D)  $0^\circ\text{C}$  and  $1 \text{ kgf/cm}^2$

Answer: Option C

**118. Which of the following is an extensive property of a system?**

- (A) Heat capacity
- (B) Molal heat capacity
- (C) Pressure
- (D) Concentration

Answer: Option A

**119. Melting of ice exemplifies a/an**

- (A) Adiabatic process
- (B) Endothermic reaction
- (C) Exothermic reaction
- (D) Process involving a chemical reaction

Answer: Option B

**120. In a homogeneous solution, the fugacity of a component depends upon the**

- (A) Pressure
- (B) Composition
- (C) Temperature
- (D) All (A), (B) and (C)

Answer: Option D

**121. Absolute zero temperature signifies the**

- (A) Minimum temperature attainable
- (B) Temperature of the heat reservoir to which a Carnot engine rejects all the heat that is taken in
- (C) Temperature of the heat reservoir to which a Carnot engine rejects no heat
- (D) None of these

Answer: Option C

**122. Compressibility factor of a gas is**

- (A) Not a function of its pressure
- (B) Not a function of its nature
- (C) Not a function of its temperature
- (D) Unity, if it follows  $PV = nRT$

Answer: Option A

**123. A gas performs the maximum work, when it expands**

- (A) Non-uniformly
- (B) Adiabatically
- (C) Isobarically
- (D) Isothermally

Answer: Option C

**124. Efficiency of a heat engine working on Carnot cycle between two temperature levels depends upon the**

- (A) Two temperatures only
- (B) Pressure of working fluid
- (C) Mass of the working fluid
- (D) Mass and pressure both of the working fluid

Answer: Option A

**125. Pick out the wrong statement.**

- (A) The chemical potential of a pure substance depends upon the temperature and pressure
- (B) The chemical potential of a component in a system is directly proportional to the escaping tendency of that component
- (C) The chemical potential of  $i$ th species ( $\mu_i$ ) in an ideal gas mixture approaches zero as the pressure or mole fraction ( $x_i$ ) tends to be zero at constant temperature
- (D) The chemical potential of species ' $i$ ' in the mixture ( $\mu_i$ ) is mathematically represented as,  $\mu_i = \partial(nG)/\partial n_i]_{T,P,n_j}$  where,  $n$ ,  $n_i$  and  $n_j$  respectively denote the total number of moles, moles of  $i^{\text{th}}$  species and all mole numbers except  $i^{\text{th}}$  species. ' $G$ ' is Gibbs molar free energy

Answer: Option C

**126. For a thermodynamic system containing ' $x$ ' chemical species, the maximum number of phases that can co-exist at equilibrium is**

- (A)  $x$
- (B)  $x + 1$
- (C)  $x + 2$
- (D)  $x + 3$

Answer: Option C

**127. Gibbs free energy of mixing at constant pressure and temperature is always**

- (A) 0
- (B)  $\infty$
- (C) + ve
- (D) - ve

Answer: Option D

**128. At \_\_\_\_\_ point, all the three phases (i.e. solid, liquid and gas) co-exist.**

- (A) Eutectic
- (B) Triple
- (C) Plait

(D) Critical  
Answer: Option B

**129. For an incompressible fluid, the \_\_\_\_\_ is a function of both pressure as well as temperature.**

- (A) Internal energy
  - (B) Enthalpy
  - (C) Entropy
  - (D) All (A), (B) & (C)
- Answer: Option B

**130. Specific \_\_\_\_\_ does not change during a phase change (e.g. sublimation, melting, vaporisation etc.).**

- (A) Entropy
  - (B) Internal energy
  - (C) Enthalpy
  - (D) Gibbs free energy
- Answer: Option D

**131. When dilute aqueous solutions of two salts are mixed, the process is associated with**

- (A) Decrease in temperature
  - (B) Increase in temperature
  - (C) No change in temperature
  - (D) Change in temperature which is a function of composition
- Answer: Option B

**132. Which of the following is Virial equation of state?**

- (A)  $(p + a/V^2)(V - b) = nRT$
  - (B)  $PV = nRT$
  - (C)  $PV = A + B/V + C/V^2 + D/V^3 + \dots$
  - (D) None of these
- Answer: Option C

**133. For a cyclic process, a fixed ratio between heat and work**

- (A) Always exists
  - (B) May exist
  - (C) Never exists
  - (D) Is difficult to predict
- Answer: Option A

**134. Joule-Thomson effect i.e., a throttling process is a constant \_\_\_\_\_ process.**

- (A) Entropy
  - (B) Temperature
  - (C) Internal energy
  - (D) Enthalpy
- Answer: Option D

**135. Equilibrium constant of a reaction varies with the**

- (A) Initial concentration of the reactant
  - (B) Pressure
  - (C) Temperature
  - (D) None of these
- Answer: Option C

**136. For an exothermic reaction**

- (A) Only enthalpy change ( $\Delta H$ ) is negative
  - (B) Only internal energy change ( $\Delta E$ ) is negative
  - (C) Both  $\Delta H$  and  $\Delta E$  are negative
  - (D) Enthalpy change is zero
- Answer: Option C

**137. Which of the following is not a reversible process?**

- (A) Expansion of an ideal gas against constant pressure
- (B) Atmospheric pressure vaporisation of water at  $100^\circ\text{C}$
- (C) Solution of NaCl in water at  $50^\circ\text{C}$



(D) None of these  
Answer: Option C

**138. For spontaneous changes in an isolated system ( $S = \text{entropy}$ )**

- (A)  $ds = 0$
  - (B)  $ds < 0$
  - (C)  $ds > 0$
  - (D)  $ds = \text{Constant}$
- Answer: Option C

**139. With increase in reduced temperature, the fugacity co-efficient of a gas at constant reduced pressure**

- (A) Increases
  - (B) Decreases
  - (C) Remain same
  - (D) Decreases linearly
- Answer: Option A

**140. The absolute entropy for all crystalline substances at absolute zero temperature is**

- (A) Zero
  - (B) Negative
  - (C) More than zero
  - (D) Indeterminate
- Answer: Option A

**141. The expression for entropy change given by,  $\Delta S = nR \ln (V_2/V_1) + nC_v \ln (T_2/T_1)$  is valid for**

- (A) Reversible isothermal volume change
  - (B) Heating of a substance
  - (C) Cooling of a substance
  - (D) Simultaneous heating and expansion of an ideal gas
- Answer: Option D

**142. In the equation,  $PV^n = \text{constant}$ , if the value of  $n = 1$ , then it represents a reversible \_\_\_\_\_ process.**

- (A) Isothermal
  - (B) Isobaric
  - (C) Polytropic
  - (D) Adiabatic
- Answer: Option A

**143. Critical temperature is defined as the temperature above which a gas will**

- (A) Not liquify (barring exceptions)
  - (B) Immediately liquify
  - (C) Never liquify however high the pressure may be
  - (D) None of these
- Answer: Option C

**144. The second law of thermodynamics states that**

- (A) The energy change of a system undergoing any reversible process is zero
  - (B) It is not possible to transfer heat from a lower temperature to a higher temperature
  - (C) The total energy of system and surrounding remains the same
  - (D) None of the above
- Answer: Option D

**145. For equilibrium process (*i.e.* reversible) in an isolated system**

- (A)  $ds = 0$
  - (B)  $ds < 0$
  - (C)  $ds > 0$
  - (D)  $ds = \text{Constant}$
- Answer: Option A

**146. A gas has a volume of 27.3 c.c. at  $0^\circ\text{C}$ . Its volume at  $10^\circ\text{C}$  (if pressure remains unchanged) will be \_\_\_\_\_ c.c.**

- (A) 2.73
- (B) 28.3

- (C) 273
- (D) 283

Answer: Option B

**147. First law of thermodynamics deals with the**

- (A) Direction of energy transfer
- (B) Reversible processes only
- (C) Irreversible processes only
- (D) None of these

Answer: Option A

**148. The energy of activation of exothermic reaction is**

- (A) Zero
- (B) Negative
- (C) Very large compared to that for endothermic reaction
- (D) Not possible to predict

Answer: Option D

**149. The first law of thermodynamics is a statement of conservation of**

- (A) Heat
- (B) Momentum
- (C) Energy
- (D) Work

Answer: Option C

**150. Which of the following is not a common refrigerant?**

- (A) Freon-12
- (B) Ethylene
- (C) Ammonia
- (D) Carbon dioxide

Answer: Option B

**151. If the internal energy of an ideal gas decreases by the same amount as the work done by the system, then the**

- (A) Process must be isobaric
- (B) Temperature must decrease
- (C) Process must be adiabatic
- (D) Both (B) and (C)

Answer: Option D

**152. Sublimation temperature of dry ice (solid CO<sub>2</sub>) is \_\_\_\_\_ °C.**

- (A) -273
- (B) 0
- (C) -78
- (D) 5

Answer: Option C

**153. As pressure approaches zero, the ratio of fugacity to pressure ( $f/P$ ) for a gas approaches**

- (A) Zero
- (B) Unity
- (C) Infinity
- (D) An indeterminate value

Answer: Option B

**154. A chemical reaction will occur spontaneously at constant pressure and temperature, if the free energy is**

- (A) Zero
- (B) Positive
- (C) Negative
- (D) None of these

Answer: Option C

**155. A two stage compressor is used to compress an ideal gas. The gas is cooled to the initial temperature after each stage. The intermediate pressure for the minimum total work**

requirement should be equal to the \_\_\_\_\_ mean of  $P_1$  and  $P_2$  (where,  $P_1$  and  $P_2$  are initial and final pressures respectively)

- (A) Logarithmic
  - (B) Arithmetic
  - (C) Geometric
  - (D) Harmonic
- Answer: Option C

156. During a reversible isothermal expansion of an ideal gas, the entropy change is

- (A) +ve
- (B) 0
- (C) -ve
- (D)  $\infty$

Answer: Option A

157. Mollier chart is a \_\_\_\_\_ plot.

- (A) Pressure vs. enthalpy
- (B) Pressure vs. volume
- (C) Enthalpy vs. entropy
- (D) Temperature vs. entropy

Answer: Option C

158. The equation,  $(d \log_e PA/d \log_e xA) = (d \log_e PA/d \log_e xB)$  applicable to a binary solution of components A and B in equilibrium with their vapors at constant temperature and pressure is called the \_\_\_\_\_ equation.

- (A) Van Laar
- (B) Margules
- (C) Gibbs-Duhem
- (D) Gibbs-Duhem-Margules

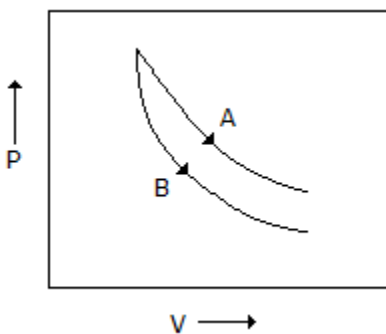
Answer: Option D

159. For a stable phase at constant pressure and temperature, the fugacity of each component in a binary system \_\_\_\_\_ as its mole fraction increases.

- (A) Decreases
- (B) Increases
- (C) Remain same
- (D) Decreases linearly

Answer: Option B

160. Consider the process A & B shown in the figure given below: In this case, it is possible that



- (A) Both the processes are adiabatic
- (B) Both the processes are isothermal
- (C) Process A is isothermal while B is adiabatic
- (D) Process A is adiabatic while B is isothermal

Answer: Option C

161. A domestic refrigerator has a/an \_\_\_\_\_ cooled condenser.

- (A) Water
- (B) Air
- (C) Evaporative
- (D) Gas

Answer: Option B

162. Rotary lime kiln is an example of a/an \_\_\_\_\_ system.

- (A) Closed
- (B) Open
- (C) Isolated
- (D) Non-thermodynamic

Answer: Option B

**163. The equilibrium constant for a chemical reaction at two different temperatures is given by**

- (A)  $Kp_2/Kp_1 = -(\Delta H/R)(1/T_2 - 1/T_1)$
- (B)  $Kp_2/Kp_1 = (\Delta H/R)(1/T_2 - 1/T_1)$
- (C)  $Kp_2/Kp_1 = \Delta H(1/T_2 - 1/T_1)$
- (D)  $Kp_2/Kp_1 = -(1/R)(1/T_2 - 1/T_1)$

Answer: Option A

**164. Isobaric process means a constant process.**

- (A) Temperature
- (B) Pressure
- (C) Volume
- (D) Entropy

Answer: Option B

**165. Pick out the wrong statement.**

- (A) System (of partially miscible liquid pairs), in which the mutual solubility increases with rise in temperature, are said to possess an upper consolute temperature
- (B) Systems, in which the mutual solubility increases with decrease in temperature, are said to possess lower consolute temperature
- (C) Nicotine-water system shows both an upper as well as a lower consolute temperature, implying that they are partially miscible between these two limiting temperatures
- (D) None of these

Answer: Option D

**166. Fugacity is a measure of the**

- (A) Escaping tendencies of the same substance in different phases of a system
- (B) Relative volatility of a mixture of two miscible liquids
- (C) Behaviour of ideal gases
- (D) None of these

Answer: Option A

**167. Pick out the wrong statement.**

- (A) The net change in entropy in any reversible cycle is always zero
- (B) The entropy of the system as a whole in an irreversible process increases
- (C) The entropy of the universe tends to a maximum
- (D) The entropy of a substance does not remain constant during a reversible adiabatic change

Answer: Option D

**168. A system is said to be at equilibrium, if the entropy of the system has reached \_\_\_\_\_ value.**

- (A) Minimum
- (B) Zero
- (C) Maximum
- (D) None of these

Answer: Option C

**169. During Joule-Thomson expansion of gases**

- (A) Enthalpy remains constant
- (B) Entropy remains constant
- (C) Temperature remains constant
- (D) None of these

Answer: Option A

**170. The kinetic energy of gas molecule is zero at**

- (A) 0°C
- (B) 273°C
- (C) 100°C
- (D) -273°C

Answer: Option D

**171. The value of Joule-Thomson co-efficient, in case where cooling occurs after the throttling process is**

- (A) 0
- (B)  $\infty$
- (C) +ve
- (D) -ve

Answer: Option C

**172. In the equation  $PV^n = \text{constant}$ , if the value of  $n = \gamma = C_p/C_v$ , then it represents a reversible \_\_\_\_\_ process.**

- (A) Isothermal
- (B) Adiabatic
- (C) Isentropic
- (D) Polytropic

Answer: Option C

**173. Joule-Thomson co-efficient is defined as**

- (A)  $\mu = (\partial P/\partial T)_H$
- (B)  $\mu = (\partial T/\partial P)_H$
- (C)  $\mu = (\partial E/\partial T)_H$
- (D)  $\mu = (\partial E/\partial P)_H$

Answer: Option B

**174. Linde gas liquefaction process employs cooling**

- (A) By throttling
- (B) By expansion in an engine
- (C) At constant pressure
- (D) None of these

Answer: Option A

**175. Gibbs free energy per mole for a pure substance is equal to the**

- (A) Latent heat of vaporisation
- (B) Chemical potential
- (C) Molal boiling point
- (D) Heat capacity

Answer: Option B

**176. For a given substance at a specified temperature, activity is \_\_\_\_\_ to fugacity.**

- (A) Directly proportional
- (B) Inversely proportional
- (C) Equal
- (D) None of these

Answer: Option A

**177. All gases except \_\_\_\_\_ shows a cooling effect during throttling process at atmospheric temperature and pressure.**

- (A) Oxygen
- (B) Nitrogen
- (C) Air
- (D) Hydrogen

Answer: Option D

**178. To obtain integrated form of Clausius-Clapeyron equation,  $\ln (P_2/P_1) = (\Delta H_v/R) (1/T_1 - 1/T_2)$  from the exact Clapeyron equation, it is assumed that the**

- (A) Volume of the liquid phase is negligible compared to that of vapour phase
- (B) Vapour phase behaves as an ideal gas
- (C) Heat of vaporisation is independent of temperature
- (D) All (A), (B) & (C)

Answer: Option D

**179. Out of the following refrigeration cycles, which one has maximum COP?**

- (A) Air cycle
- (B) Carnot cycle
- (C) Ordinary vapor compression cycle

(D) Vapor compression with a reversible expansion engine

Answer: Option B

**180. Joule-Thomson co-efficient which is defined as,  $\eta = (\partial T/\partial P)_H = 1/C_p (\partial H/\partial T)_P$ , changes sign at a temperature known as inversion temperature. The value of Joule-Thomson co-efficient at inversion temperature is**

(A) 0

(B)  $\infty$

(C) +ve

(D) -ve

Answer: Option A

**181. In case of a reversible process (following  $p v^n = \text{constant}$ ), work obtained for trebling the volume ( $v_1 = 1 \text{ m}^3$  and  $v_2 = 3 \text{ m}^3$ ) is maximum, when the value of 'n' is**

(A) 0

(B) 1

(C)  $\gamma = 1.44$

(D) 1.66

Answer: Option A

**182. Absorption/evolution of heat during conversion of a substance from one allotropic form to another is termed as the heat of**

(A) Sublimation

(B) Fusion

(C) Transition

(D) Vaporisation

Answer: Option C

**183. Which of the following is true for Virial equation of state?**

(A) Virial co-efficients are universal constants

(B) Virial co-efficients 'B' represents three body interactions

(C) Virial co-efficients are function of temperature only

(D) For some gases, Virial equations and ideal gas equations are the same

Answer: Option C

**184. Pick out the wrong statement.**

(A) Activity co-efficient is dimensionless.

(B) In case of an ideal gas, the fugacity is equal to its pressure.

(C) In a mixture of ideal gases, the fugacity of a component is equal to the partial pressure of the component.

(D) The fugacity co-efficient is zero for an ideal gas

Answer: Option D

**185. The gas law ( $PV = RT$ ) is true for an \_\_\_\_\_ change.**

(A) Isothermal

(B) Adiabatic

(C) Both (A) & (B)

(D) Neither (A) nor (B)

Answer: Option C

**186. The heat capacities for the ideal gas state depend upon the**

(A) Pressure

(B) Temperature

(C) Both (A) & (B)

(D) Neither (A) nor (B)

Answer: Option B

**187. The work done in isothermal compression compared to that in adiabatic compression will be**

(A) Less

(B) More

(C) Same

(D) More or less depending upon the extent of work done

Answer: Option B

**188. Compound having large heat of formation is**

- (A) More stable
- (B) Less stable
- (C) Not at all stable (like nascent O<sub>2</sub>)
- (D) Either more or less stable; depends on the compound

Answer: Option A

**189. Water on heating from 1 to 4°C**

- (A) Contracts
- (B) Expands
- (C) Has same volume
- (D) May contract or expand

Answer: Option A

**190. The equation,  $C_p - C_v = R$ , is true for \_\_\_\_\_ gas.**

- (A) No
- (B) Any real
- (C) Only ideal
- (D) Both (B) and (C)

Answer: Option C

**191. Pick out the wrong statement.**

- (A) The values of  $(\partial P/\partial V)_T$  and  $(\partial^2 P/\partial V^2)_T$  are zero for a real gas at its critical point
- (B) Heat transferred is equal to the change in the enthalpy of the system, for a constant pressure, non-flow, mechanically reversible process
- (C) Thermal efficiency of a Carnot engine depends upon the properties of the working fluid besides the source & sink temperatures
- (D) During a reversible adiabatic process, the entropy of a substance remains constant

Answer: Option C

**192. What happens in a reversible adiabatic compression?**

- (A) Heating occurs
- (B) Cooling occurs
- (C) Pressure is constant
- (D) Temperature is constant

Answer: Option A

**193. In the equation,  $PV^n = \text{constant}$ , if the value of  $n$  is in between 1 and  $\gamma$  (i.e.  $C_p/C_v$ ), then it represents a reversible \_\_\_\_\_ process.**

- (A) Isometric
- (B) Polytropic
- (C) Isentropic
- (D) Isobaric

Answer: Option B

**194. Maximum work that could be secured by expanding the gas over a given pressure range is the \_\_\_\_\_ work.**

- (A) Isothermal
- (B) Adiabatic
- (C) Isentropic
- (D) None of these

Answer: Option A

**195. The chemical potential of any constituent of an ideal solution depends on the \_\_\_\_\_ of the solution.**

- (A) Temperature
- (B) Pressure
- (C) Composition
- (D) All (A), (B) and (C)

Answer: Option D

**196. Which of the following is not affected by temperature changes?**

- (A) Fugacity
- (B) Activity co-efficient
- (C) Free energy

(D) None of these  
Answer: Option D

**197. For multi-component multiple phases to be in equilibrium at the same pressure and temperature, the \_\_\_\_\_ of each component must be same in all phases.**

- (A) Chemical potential
  - (B) Fugacity
  - (C) Both (A) and (B)
  - (D) Neither (A) nor (B)
- Answer: Option C

**198. Helmholtz free energy (A) is defined as**

- (A)  $A = H - TS$
  - (B)  $A = E - TS$
  - (C)  $A = H + TS$
  - (D) None of these
- Answer: Option B

**199. For a spontaneous process, free energy**

- (A) Is zero
  - (B) Increases
  - (C) Decreases whereas the entropy increases
  - (D) And entropy both decrease
- Answer: Option C

**200. The Carnot co-efficient of performance (COP) of a domestic air conditioner compared to a household refrigerator is**

- (A) Less
  - (B) More
  - (C) Same
  - (D) Dependent on climatic conditions
- Answer: Option A

**201. In an ideal refrigeration cycle, the change in internal energy of the fluid is**

- (A) +ve
  - (B) -ve
  - (C) 0
  - (D) Either of the above three; depends on the nature of refrigerant
- Answer: Option C

**202. Melting of ice is an example of an \_\_\_\_\_ process.**

- (A) Adiabatic
  - (B) Isothermal
  - (C) Isometric
  - (D) None of these
- Answer: Option B

**203. Which of the following equations is used for the prediction of activity co-efficient from experiments?**

- (A) Van Laar equation
  - (B) Margules equation
  - (C) Wilson's equation
  - (D) All (A), (B) and (C)
- Answer: Option D

**204. Measurement of thermodynamic property of temperature is facilitated by \_\_\_\_\_ law of thermodynamics.**

- (A) 1st
  - (B) Zeroth
  - (C) 3rd
  - (D) None of these
- Answer: Option B



**205. A system undergoes a change from a given initial state to a given final state either by an irreversible process or by a reversible process, then (where,  $\Delta S_I$  and  $\Delta S_R$  are the entropy changes of the system for the irreversible and reversible processes respectively)**

- (A)  $\Delta S_I$  is always  $< \Delta S_R$
- (B)  $\Delta S_I$  is sometimes  $> \Delta S_R$
- (C)  $\Delta S_I$  is always  $> \Delta S_R$
- (D)  $\Delta S_I$  is always  $= \Delta S_R$

Answer: Option C

**206. Refrigeration cycle**

- (A) Violates second law of thermodynamics
- (B) Involves transfer of heat from low temperature to high temperature
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option B

**207. On a P-V diagram of an ideal gas, suppose a reversible adiabatic line intersects a reversible isothermal line at point A. Then at a point A, the slope of the reversible adiabatic line ( $\partial P/\partial V)_S$  and the slope of the reversible isothermal line ( $\partial P/\partial V)_T$  are related as (where,  $\gamma = C_p/C_v$ )**

- (A)  $(\partial P/\partial V)_S = (\partial P/\partial V)_T$
- (B)  $(\partial P/\partial V)_S = [(\partial P/\partial V)_T]^\gamma$
- (C)  $(\partial P/\partial V)_S = \gamma(\partial P/\partial V)_T$
- (D)  $(\partial P/\partial V)_S = 1/\gamma(\partial P/\partial V)_T$

Answer: Option C

**208. In the reaction,  $C + O_2 \rightarrow CO_2$ ;  $\Delta H = -94$  kcal. What is the heat content (enthalpy) of  $O_2$ ?**

- (A) -94 kcal
- (B)  $> -94$  kcal
- (C)  $< -94$  kcal
- (D) Zero

Answer: Option D

**209. "At the absolute zero temperature, the entropy of every perfectly crystalline substance becomes zero". This follows from the**

- (A) Third law of thermodynamics
- (B) Second law of thermodynamics
- (C) Nernst heat theorem
- (D) Maxwell's relations

Answer: Option A

**210. The expression for the work done for a reversible polytropic process can be used to obtain the expression for work done for all processes, except reversible \_\_\_\_\_ process.**

- (A) Isobaric
- (B) Isothermal
- (C) Adiabatic
- (D) None of these

Answer: Option B

**211. In case of vapour compression refrigeration system, elevating the evaporator temperature (keeping the condenser temperature constant) results in**

- (A) Enhanced COP
- (B) Decreased COP
- (C) No change in the value of COP
- (D) Increased or decreased COP; depending upon the type of refrigerant

Answer: Option A

**212. Which of the following identities can be most easily used to verify steam table data for superheated steam?**

- (A)  $(\partial T/\partial V)_S = (\partial p/\partial S)_V$
- (B)  $(\partial T/\partial P)_S = (\partial V/\partial S)_P$
- (C)  $(\partial P/\partial T)_V = (\partial S/\partial V)_T$
- (D)  $(\partial V/\partial T)_P = -(\partial S/\partial P)_T$

Answer: Option D

**213. The third law of thermodynamics states that the**

- (A) Heat capacity of a crystalline solid is zero at absolute zero temperature
  - (B) Heat transfer from low temperature to high temperature source is not possible without external work
  - (C) Gases having same reduced properties behaves similarly
  - (D) None of these
- Answer: Option A

**214. 1st law of thermodynamics is nothing but the law of conservation of**

- (A) Momentum
  - (B) Mass
  - (C) Energy
  - (D) None of these
- Answer: Option C

**215. Vapour which is at a pressure smaller than the saturation pressure for the temperature involved is called a \_\_\_\_\_ vapour.**

- (A) Superheated
  - (B) Desuperheated
  - (C) Non-condensable
  - (D) None of these
- Answer: Option A

**216. An ideal liquid refrigerant should**

- (A) Not have a sub-atmospheric vapour pressure at the temperature in the refrigerator coils
  - (B) Not have unduly high vapour pressure at the condenser temperature
  - (C) Both (A) and (B)
  - (D) Have low specific heat
- Answer: Option C

**217. High pressure steam is expanded adiabatically and reversibly through a well insulated turbine, which produces some shaft work. If the enthalpy change and entropy change across the turbine are represented by  $\Delta H$  and  $\Delta S$  respectively for this process:**

- (A)  $\Delta H = 0$  and  $\Delta S = 0$
  - (B)  $\Delta H \neq 0$  and  $\Delta S = 0$
  - (C)  $\Delta H \neq 0$  and  $\Delta S \neq 0$
  - (D)  $\Delta H = 0$  and  $\Delta S \neq 0$
- Answer: Option B

**218.  $C_p$  of a gas at its critical temperature and pressure**

- (A) Becomes zero
  - (B) Becomes infinity
  - (C) Equals 1 kcal/kmol °K
  - (D) Equals 0.24 kcal/kmol °K
- Answer: Option B

**219. Compressibility factor for almost all the gases are approximately same at the same**

- (A) Pressure and temperature
  - (B) Reduced pressure and reduced temperature
  - (C) Critical pressure and critical temperature
  - (D) None of these
- Answer: Option B

**220. Which law of the thermodynamics provides basis for measuring the thermodynamic property?**

- (A) First law
  - (B) Zeroth law
  - (C) Third law
  - (D) Second law
- Answer: Option B

**221. Which of the following will increase the volume of a real gas by four times?**

- (A) Doubling the absolute temperature as well as pressure of the gas
- (B) Reducing pressure to one fourth at constant temperature
- (C) Reducing temperature to one fourth at constant pressure
- (D) Reducing the temperature to half and doubling the pressure

Answer: Option B

**222. Gibbs phase rule finds application, when heat transfer occurs by**

- (A) Conduction
- (B) Convection
- (C) Radiation
- (D) Condensation

Answer: Option D

**223. Second law of thermodynamics is concerned with the**

- (A) Amount of energy transferred
- (B) Direction of energy transfer
- (C) Irreversible processes only
- (D) Non-cyclic processes only

Answer: Option B

**224. In jet refrigerators, the refrigerating fluid is practically always**

- (A) Water
- (B) Ammonia
- (C) Freon
- (D) Brine

Answer: Option A

**225. In case of the decomposition of hydroiodic acid ( $2\text{HI} \rightleftharpoons \text{H}_2 + \text{I}_2$ ), addition of  $\text{H}_2$  (at equilibrium condition) will**

- (A) Increase the partial pressure of  $\text{I}_2$
- (B) Decrease the partial pressure of HI
- (C) Diminish the degree of dissociation of HI
- (D) None of these

Answer: Option C

**226.  $(\partial T/\partial P)_H$  is the mathematical expression for**

- (A) Specific heat at constant pressure ( $C_p$ )
- (B) Specific heat at constant volume ( $C_v$ )
- (C) Joule-Thompson co-efficient
- (D) None of these

Answer: Option C

**227. Pick out the Clausius-Clapeyron equation from the following:**

- (A)  $dP/dT = \Delta H/T\Delta V$
- (B)  $\ln P = -(\Delta H/RT) + \text{constant}$
- (C)  $\Delta F = \Delta H + T[\partial(\Delta F)/\partial T]_P$
- (D) None of these

Answer: Option B

**228. Throttling process is a/an \_\_\_\_\_ process.**

- (A) Reversible and isothermal
- (B) Irreversible and constant enthalpy
- (C) Reversible and constant entropy
- (D) Reversible and constant enthalpy

Answer: Option B

**229. Internal energy change of a system over one complete cycle in a cyclic process is**

- (A) Zero
- (B) +ve
- (C) -ve
- (D) Dependent on the path

Answer: Option A

**230.  $C_v$  for an ideal gas**

- (A) Does not depend upon temperature
- (B) Is independent of pressure only
- (C) Is independent of volume only
- (D) Is independent of both pressure and volume

Answer: Option D

**231. Generation of heat by friction is an example of a/an \_\_\_\_\_ change.**

- (A) Isothermal
- (B) Irreversible
- (C) Adiabatic
- (D) Reversible

Answer: Option B

**232. The internal energy of an incompressible fluid depends upon its**

- (A) Pressure
- (B) Temperature
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option B

**233. The variation of heat of reaction with temperature at constant pressure is given by the \_\_\_\_\_ law.**

- (A) Kelvin's
- (B) Antoine's
- (C) Kirchoff's
- (D) None of these

Answer: Option C

**234. In a working refrigerator, the value of COP is always**

- (A) 0
- (B)  $< 0$
- (C)  $< 1$
- (D)  $> 1$

Answer: Option D

**235. The unit of fugacity is the same as that of the**

- (A) Pressure
- (B) Temperature
- (C) Volume
- (D) Molar concentration

Answer: Option A

**236. Ideal refrigeration cycle is**

- (A) Same as Carnot cycle
- (B) Same as reverse Carnot cycle
- (C) Dependent on the refrigerant's properties
- (D) The least efficient of all refrigeration processes

Answer: Option B

**237. Variation of equilibrium pressure with temperature for any two phases of a given substances is given by the \_\_\_\_\_ equation.**

- (A) Gibbs-Duhem
- (B) Maxwell's
- (C) Clapeyron
- (D) None of these

Answer: Option C

**238. When a system is in equilibrium for all possible processes, the differential or finite change of entropy is**

- (A)  $< 0$
- (B)  $> 0$
- (C)  $= 0$
- (D) None of these

Answer: Option A

**239. Entropy of an ideal gas depends upon its**

- (A) Pressure
- (B) Temperature
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

**240. An irreversible process**

- (A) Is the analog of linear frictionless motion in machines
- (B) Is an idealised visualisation of behaviour of a system
- (C) Yields the maximum amount of work
- (D) Yields an amount of work less than that of a reversible process

Answer: Option D

**241. Critical compressibility factor for all substances**

- (A) Are more or less constant (vary from 0.2 to 0.3)
- (B) Vary as square of the absolute temperature
- (C) Vary as square of the absolute pressure
- (D) None of these

Answer: Option A

**242. The expression,  $nRT \ln(P_1/P_2)$ , is for the \_\_\_\_\_ of an ideal gas.**

- (A) Compressibility
- (B) Work done under adiabatic condition
- (C) Work done under isothermal condition
- (D) Co-efficient of thermal expansion

Answer: Option C

**243. For an ideal liquid solution, which of the following is unity?**

- (A) Activity
- (B) Fugacity
- (C) Activity co-efficient
- (D) Fugacity co-efficient

Answer: Option C

**244. Pick out the wrong statement pertaining to the decomposition of  $\text{PCl}_5$  represented by,  $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$ . Degree of dissociation of  $\text{PCl}_5$  will**

- (A) Decrease on addition of  $\text{Cl}_2$
- (B) Increase on addition of an inert gas at constant pressure
- (C) Decrease on increasing the pressure of the system
- (D) None of these

Answer: Option D

**245. The necessary and sufficient condition for equilibrium between two phases is**

- (A) The concentration of each component should be same in the two phases
- (B) The temperature of each phase should be same
- (C) The pressure should be same in the two phases
- (D) The chemical potential of each component should be same in the two phases

Answer: Option D

**246. As the temperature is lowered towards the absolute zero, the value of the quantity  $(\partial \Delta F / \partial T)$  approaches**

- (A) Zero
- (B) Unity
- (C) Infinity
- (D) None of these

Answer: Option A

**247. The relation connecting the fugacities of various components in a solution with one another and to composition at constant temperature and pressure is called the \_\_\_\_\_ equation.**

- (A) Gibbs-Duhem
- (B) Van Laar
- (C) Gibbs-Helmholtz
- (D) Margules

Answer: Option A

**248. Thermal efficiency of a Carnot engine can approach 100%, only when the temperature of the**

- (A) Cold reservoir approaches zero
- (B) Hot reservoir approaches infinity

- (C) Either (A) or (B)  
(D) Neither (A) nor (B)  
Answer: Option C

**249. Equilibrium constant decreases as the temperature**

- (A) Increases, for an exothermic reaction  
(B) Decreases, for an exothermic reaction  
(C) Increases, for an endothermic reaction  
(D) None of these

Answer: Option A

**250. \_\_\_\_\_ calorimeter is normally used for measuring the dryness fraction of steam, when it is very low.**

- (A) Bucket  
(B) Throttling  
(C) Separating  
(D) A combination of separating & throttling

Answer: Option D

**251. Pick out the wrong statement.**

- (A) A refrigeration cycle violates the second law of thermodynamics  
(B) Refrigeration cycle is normally represented by a temperature vs. entropy plot  
(C) In a refrigerator, work required decreases as the temperature of the refrigerator and the temperature at which heat is rejected increases  
(D) One ton of refrigeration is equivalent to the rate of heat absorption equal to 3.53 kW

Answer: Option A

**252. The necessary condition for phase equilibrium in a multiphase system of N components is that the**

- (A) Chemical potentials of a given component should be equal in all phases  
(B) Chemical potentials of all components should be same in a particular phase  
(C) Sum of the chemical potentials of any given component in all the phases should be the same  
(D) None of these

Answer: Option A

**253. The main feature of Carnot refrigeration cycle is that, it**

- (A) Does not need the addition of external work for its functioning  
(B) Transfers heat from high temperature to low temperature  
(C) Accomplishes the reverse effect of the heat engine  
(D) None of these

Answer: Option C

**254. The chemical potential of a component ( $\mu_i$ ) of a phase is the amount by which its capacity for doing all work, barring work of expansion is increased per unit amount of substance added for an infinitesimal addition at constant temperature and pressure. It is given by**

- (A)  $(\partial E/\partial n_i)_{S, v, n_j}$   
(B)  $(\partial G/\partial n_i)_{T, P, n_j} = (\partial A/\partial n_i)_{T, v, n_j}$   
(C)  $(\partial H/\partial n_i)_{S, P, n_j}$   
(D) All (A), (B) and (C)

Answer: Option D

**255. In a homogeneous solution, the activity co-efficient of a component depends upon the**

- (A) Pressure  
(B) Composition  
(C) Temperature  
(D) All (A), (B) and (C)

Answer: Option D

**256. In case of a close thermodynamic system, there is \_\_\_\_\_ across the boundaries.**

- (A) No heat and mass transfer  
(B) No mass transfer but heat transfer  
(C) Mass and energy transfer  
(D) None of these

Answer: Option B

**257. Pick out the wrong statement.**

- (A) At constant pressure, solubility of a gas in a liquid diminishes with rise in temperature
- (B) Normally, the gases which are easily liquefied are more soluble in common solvents
- (C) The gases which are capable of forming ions in aqueous solution are much more soluble in water than in other solvents
- (D) At constant pressure, solubility of a gas in a liquid increases with rise in temperature

Answer: Option A

**258. Entropy of a substance remains constant during a/an \_\_\_\_\_ change.**

- (A) Reversible isothermal
- (B) Irreversible isothermal
- (C) Reversible adiabatic
- (D) None of these

Answer: Option C

**259. Heating of water under atmospheric pressure is an \_\_\_\_\_ process.**

- (A) Isochoric
- (B) Isobaric
- (C) Adiabatic
- (D) Isothermal

Answer: Option B

**260. With increase in compression ratio, the efficiency of the otto engine**

- (A) Increases
- (B) Decreases
- (C) Remain constant
- (D) Increases linearly

Answer: Option A

**261. If we increase the pressure on a substance (which is at its triple point), then the triple point**

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) May increase or decrease; depends on the substance

Answer: Option C

**262. When liquid and vapour phases of one component system are in equilibrium (at a given temperature and pressure), the molar free energy is**

- (A) More in vapour phase
- (B) More in liquid phase
- (C) Same in both the phases
- (D) Replaced by chemical potential which is more in vapour phase

Answer: Option C

**263. Degree of freedom of the system ice-water-vapour will be**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option A

**264. A refrigerator may be termed as a**

- (A) Heat pump
- (B) Heat engine
- (C) Carnot engine
- (D) None of these

Answer: Option A

**265. Filling of gas from a high pressure cylinder into small bottles is an example of a/an \_\_\_\_\_ process.**

- (A) Equilibrium
- (B) Adiabatic
- (C) Steady
- (D) Unsteady

Answer: Option D

**266. Adiabatic compression of a saturated water vapour makes it**

- (A) Supersaturated
- (B) Superheated
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option B

**267. Pick out the undesirable property for a good refrigerant.**

- (A) High thermal conductivity
- (B) Low freezing point
- (C) Large latent heat of vaporisation
- (D) High viscosity

Answer: Option D

**268. In case of an \_\_\_\_\_ process, the temperature of the system increases.**

- (A) Isothermal compression
- (B) Isothermal expansion
- (C) Adiabatic expansion
- (D) Adiabatic compression

Answer: Option D

**269. If the vapour pressure at two temperatures of a solid phase in equilibrium with its liquid phase are known, then the latent heat of fusion can be calculated by the**

- (A) Maxwell's equation
- (B) Clausius-Clapeyron Equation
- (C) Van Laar equation
- (D) Nernst Heat Theorem

Answer: Option B

**270. Free energy change of mixing two liquid substances is a function of the**

- (A) Concentration of the constituents only
- (B) Quantities of the constituents only
- (C) Temperature only
- (D) All (A), (B) and (C)

Answer: Option D

**271. For water at 300°C, it has a vapour pressure 8592.7 kPa and fugacity 6738.9 kPa Under these conditions, one mole of water in liquid phase has a volume of 25.28 cm<sup>3</sup> and that in vapour phase in 391.1 cm<sup>3</sup>. Fugacity of water (in kPa) at 9000 kPa will be**

- (A) 6738.9
- (B) 6753.5
- (C) 7058.3
- (D) 9000

Answer: Option B

**272. Gibbs-Helmholtz equation is**

- (A)  $\Delta F = \Delta H + T [\partial(\Delta F)/\partial T]_P$
- (B)  $\Delta F = \Delta H - T\Delta T$
- (C)  $d(E - TS) T, V < 0$
- (D)  $dP/dT = \Delta H_{\text{vap}}/T \cdot \Delta V_{\text{vap}}$

Answer: Option A

**273. For an ideal gas, the internal energy depends upon its \_\_\_\_\_ only.**

- (A) Molecular size
- (B) Temperature
- (C) Volume
- (D) Pressure

Answer: Option B

**274. Pick out the correct statement:**

- (A) In an isothermal system, irreversible work is more than reversible work
- (B) Under reversible conditions, the adiabatic work is less than isothermal work
- (C) Heat, work, enthalpy and entropy are all 'state functions'
- (D) Matter and energy cannot be exchanged with the surroundings in a closed system



Answer: Option B

**275. Pick out the extensive property out of the following.**

- (A) Surface tension
- (B) Free energy
- (C) Specific heat
- (D) Refractive index

Answer: Option B

**276. The equation,  $PV = nRT$ , is best obeyed by gases at**

- (A) Low pressure & high temperature
- (B) High pressure & low temperature
- (C) Low pressure & low temperature
- (D) None of these

Answer: Option A

**277. The temperature at the eutectic point of the system is the \_\_\_\_\_ temperature that can be attained in the system.**

- (A) Lowest
- (B) Highest
- (C) Average
- (D) None of these

Answer: Option A

**278. Heat of reaction at constant volume is identified with \_\_\_\_\_ change.**

- (A) Enthalpy
- (B) Internal energy
- (C) Either (A) or (B)
- (D) Neither (A) nor (B)

Answer: Option B

**279. Pick out the correct statement.**

- (A) Compression ratio of an Otto engine is comparatively higher than a diesel engine
- (B) Efficiency of an Otto engine is higher than that of a diesel engine for the same compression ratio
- (C) Otto engine efficiency decreases with the rise in compression ratio, due to decrease in work produced per quantity of heat
- (D) Diesel engine normally operates at lower compression ratio than an Otto engine for an equal output of work

Answer: Option B

**280. The equation  $DU = Tds - PdV$  is applicable to infinitesimal changes occurring in**

- (A) An open system of constant composition
- (B) A closed system of constant composition
- (C) An open system with changes in composition
- (D) A closed system with changes in composition

Answer: Option D

**281. The value of  $C_p$  &  $C_v$  respectively for monatomic gases in Kcal/kg Mole. $^{\circ}$ K are**

- (A) 5 & 3
- (B) 3.987 & 1.987
- (C) 1.987 & 0.66
- (D) 0.66 & 1.987

Answer: Option A

**282. Which of the following is not an intensive property?**

- (A) Molar heat capacity
- (B) Internal energy
- (C) Viscosity
- (D) None of these

Answer: Option B

**283. Which of the following represents the Virial equation of state?**

- (A)  $T = [RT/(V - b)] - [a/\sqrt{T} \cdot V(V + b)]$
- (B)  $PV/RT = 1 + (B/V) + (C/V^2) + \dots$

(C)  $n_1u_2 + \mu_2\mu_1 = 0$

(D) None of these

Answer: Option B

**284. Van Laar equation deals with the activity co-efficients in**

(A) Binary solutions

(B) Ternary solutions

(C) Azeotropic mixture only

(D) None of these

Answer: Option A

**285. Pick out the wrong statement:**

(A) The expansion of a gas in vacuum is an irreversible process

(B) An isometric process is a constant pressure process

(C) Entropy change for a reversible adiabatic process is zero

(D) Free energy change for a spontaneous process is negative

Answer: Option B

**286. The extensive properties are**

(A) Volume, mass and number of moles

(B) Free energy, entropy and enthalpy

(C) Both (A) and (B)

(D) None of these

Answer: Option C

**287. For organic compounds, group contribution method can be used for the estimation of**

(A) Critical properties

(B) Specific gravity

(C) Specific volume

(D) Thermal conductivity

Answer: Option A

**288. In an ideal gas mixture, fugacity of a species is equal to its**

(A) Vapor pressure

(B) Partial pressure

(C) Chemical potential

(D) None of these

Answer: Option B

**289. \_\_\_\_\_ increases with increase in pressure.**

(A) The melting point of wax

(B) The boiling point of a liquid

(C) Both (A) and (B)

(D) Neither (A) nor (B)

Answer: Option C

**290. A large iceberg melts at the base, but not at the top, because of the reason that**

(A) Ice at the base contains impurities which lowers its melting point

(B) Due to the high pressure at the base, its melting point reduces

(C) The iceberg remains in a warmer condition at the base

(D) All (A), (B) and (C)

Answer: Option B

**291. The enthalpy change when ammonia gas is dissolved in water is called the heat of**

(A) Solution

(B) Formation

(C) Dilution

(D) Combustion

Answer: Option A

**292. At normal boiling point, molar entropy of vaporisation is \_\_\_\_\_ Joule/K<sup>o</sup>.mole.**

(A) 72

(B) 92

(C) 142

(D) 192

Answer: Option B

**293. Trouton's ratio is given by (where  $\lambda_b$ , = molal heat of vaporisation of a substance at its normal boiling point, kcal/kmol  $T_b$  = normal boiling point, °K)**

- (A)  $\lambda_b/T_b$
- (B)  $T_b/\lambda_b$
- (C)  $\sqrt{(\lambda_b/T_b)}$
- (D)  $\sqrt{(T_b/\lambda_b)}$

Answer: Option A

**294. The theoretical minimum work required to separate one mole of a liquid mixture at 1 atm, containing 50 mole % each of n- heptane and n- octane into pure compounds each at 1 atm is**

- (A)  $-2 RT \ln 0.5$
- (B)  $-RT \ln 0.5$
- (C)  $0.5 RT$
- (D)  $2 RT$

Answer: Option B

**295. Joule-Thomson co-efficient depends on the**

- (A) Pressure
- (B) Temperature
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option C

**296. \_\_\_\_\_ Equation predicts the activity co-efficient from experimental data.**

- (A) Lewis-Randall
- (B) Margules
- (C) Van Laar
- (D) Both (B) & (C)

Answer: Option D

**297. Which of the following processes cannot be made reversible even under ideal condition of operation?**

- (A) Free expansion of a gas
- (B) Compression of air in a compressor
- (C) Expansion of steam in a turbine
- (D) All (A), (B) & (C)

Answer: Option A

**298. Charles' law for gases states that**

- (A)  $V/T = \text{Constant}$
- (B)  $V \propto 1/T$
- (C)  $V \propto 1/P$
- (D)  $PV/T = \text{Constant}$

Answer: Option A

**299. "Law of corresponding states" says that**

- (A) Two different gases behave similarly, if their reduced properties (*i.e.* P, V and T) are same
- (B) The surface of separation (*i. e.* the meniscus) between liquid and vapour phase disappears at the critical temperature
- (C) No gas can be liquefied above the critical temperature, howsoever high the pressure may be.
- (D) The molar heat of energy of gas at constant volume should be nearly constant (about 3 calories)

Answer: Option A

**300. At equilibrium condition, the chemical potential of a material in different phases in contact with each other is equal. The chemical potential for a real gas ( $\mu$ ) is given by (where,  $\mu^\circ$  = standard chemical potential at unit fugacity ( $f^\circ = 1 \text{ atm.}$ ) and the gas behaves ideally.)**

- (A)  $\mu^\circ + RT \ln f$
- (B)  $\mu^\circ + R \ln f$
- (C)  $\mu^\circ + T \ln f$
- (D)  $\mu^\circ + R/T \ln f$

Answer: Option A

**301. Internal energy of an element at 1 atm and 25° C is \_\_\_\_\_ kcal/kg.mole.**

- (A) 0
- (B) 273
- (C) 25
- (D) None of these

Answer: Option A

**302. Compressibility factor-reduced pressure plot on reduced co-ordinates facilitates**

- (A) Use of only one graph for all gases
- (B) Covering of wide range
- (C) Easier plotting
- (D) More accurate plotting

Answer: Option A

**303. For a constant volume process \_\_\_\_\_ by the system is used only to increase the internal energy.**

- (A) Heat absorbed
- (B) Work done
- (C) Both (A) & (B)
- (D) Neither (A) nor (B)

Answer: Option A

**304. All gases during throttling process at atmospheric temperature and pressure show a cooling effect except**

- (A) CO<sub>2</sub>
- (B) H<sub>2</sub>
- (C) O<sub>2</sub>
- (D) N<sub>2</sub>

Answer: Option B

**305. A change in state involving a decrease in entropy can be spontaneous, only if**

- (A) It is exothermic
- (B) It is isenthalpic
- (C) It takes place isothermally
- (D) It takes place at constant volume

Answer: Option A

**306. The ratio of equilibrium constants ( $K_{p2}/K_{p1}$ ) at two different temperatures is given by**

- (A)  $(R/\Delta H) (1/T_1 - 1/T_2)$
- (B)  $(\Delta H/R) (1/T_1 - 1/T_2)$
- (C)  $(\Delta H/R) (1/T_2 - 1/T_1)$
- (D)  $(1/R) (1/T_1 - 1/T_2)$

Answer: Option B

**307. Specific \_\_\_\_\_ does not change during phase change at constant temperature and pressure.**

- (A) Entropy
- (B) Gibbs energy
- (C) Internal energy
- (D) Enthalpy

Answer: Option B

**308. In the decomposition of PCl<sub>5</sub> represented by, PCl<sub>5</sub> ⇌ PCl<sub>3</sub> + Cl<sub>2</sub>, decrease in the pressure of the system will \_\_\_\_\_ the degree of dissociation of PCl<sub>5</sub>.**

- (A) Increase
- (B) Decrease
- (C) Not alter
- (D) None of these

Answer: Option A

**309. High \_\_\_\_\_ is an undesirable property for a good refrigerant.**

- (A) Specific heat
- (B) Latent heat of vaporisation
- (C) Viscosity
- (D) Specific vapor volume

Answer: Option C

**310. Pick out the correct equation relating 'F' and 'A'.**

(A)  $F = A + PV$

(B)  $F = E + A$

(C)  $F = A - TS$

(D)  $F = A + TS$

Answer: Option A

**311. Which of the following liquid metals has the highest thermal conductivity?**

(A) Molten sodium

(B) Molten lead

(C) Mercury

(D) Molten potassium

Answer: Option A

**312. A cylinder contains 640 gm of liquid oxygen. The volume occupied (in litres) by the oxygen, when it is released and brought to standard conditions (0°C, 760 mm Hg) will be \_\_\_\_\_ litres.**

(A) 448

(B) 224

(C) 22.4

(D) Data insufficient; can't be computed

Answer: Option A

**313. If heat contents of  $\text{CH}_4$ ,  $\text{C}_2\text{H}_4$  and  $\text{C}_3\text{H}_8$  are -17.9, 12.5 and -24.8 kcal/mole respectively, then  $\Delta H$  for the reaction  $\text{CH}_4(g) + \text{C}_2\text{H}_4(g) \rightleftharpoons \text{C}_3\text{H}_8(g)$  will be \_\_\_\_\_ Kcal.**

(A) -19.4

(B) -30.2

(C) 55.2

(D) -55.2

Answer: Option A

**314. Which of the following is not an intensive property?**

(A) Chemical potential

(B) Surface tension

(C) Heat capacity

(D) None of these

Answer: Option C

**315.  $\gamma$  = specific heat ratio of an ideal gas is equal to**

(A)  $C_p/C_v$

(B)  $C_p/(C_p - R)$

(C)  $1 + (R/C_v)$

(D) All (A), (B) and (C)

Answer: Option D

**316. For an ideal gas, the activity co-efficient is**

(A) Directly proportional to pressure

(B) Inversely proportional to pressure

(C) Unity at all pressures

(D) None of these

Answer: Option C

**317. As the time is passing, entropy of the universe**

(A) Is increasing

(B) Is decreasing

(C) Remain constant

(D) Data insufficient, can't be predicted

Answer: Option A

**318. In the equation,  $PV^n = \text{constant}$ , if the value of  $n = \pm \infty$ , then it represents a reversible \_\_\_\_\_ process.**

(A) Adiabatic

(B) Isometric

- (C) Isentropic
  - (D) Isothermal
- Answer: Option B

**319. The acentric factor of a material, ' $\omega$ ', is defined as  $\omega = -\log_{10}(P_r^{sat})T_r^{-1} = 0.7$ , where,  $P_r^{sat} =$  reduced vapor pressure,  $T_r =$  reduced temperature. The value of acentric factor is always**

- (A)  $> 2$
- (B)  $< 1$
- (C)  $> 1$
- (D)  $< 3$

Answer: Option B

**320. Which of the following is not an intensive property?**

- (A) Volume
- (B) Density
- (C) Temperature
- (D) Pressure

Answer: Option A

**321. "If different processes are used to bring about the same chemical reaction, the enthalpy change is same for all of them". This is \_\_\_\_\_ law.**

- (A) Hess's
- (B) Kirchoff's
- (C) Lavoisier and Laplace
- (D) None of these

Answer: Option A

**322. Steam undergoes isentropic expansion in a turbine from 5000 kPa and 400°C (entropy = 6.65 kJ/kg K) to 150 kPa) (entropy of saturated liquid = 1.4336 kJ/kg. K, entropy of saturated vapour = 7.2234 kJ/kg. K) The exit condition of steam is**

- (A) Superheated vapour
- (B) Partially condensed vapour with quality of 0.9
- (C) Saturated vapour
- (D) Partially condensed vapour with quality of 0.1

Answer: Option A

**323. A gas can be liquefied by pressure alone only, when its temperature is \_\_\_\_\_ its critical temperature.**

- (A) Less than
- (B) More than
- (C) Equal to or higher than
- (D) Less than or equal to

Answer: Option D

**324. The expression,  $\Delta G = nRT \cdot \ln(P_2/P_1)$ , gives the free energy change**

- (A) With pressure changes at constant temperature
- (B) Under reversible isothermal volume change
- (C) During heating of an ideal gas
- (D) During cooling of an ideal gas

Answer: Option A

**325. Heat is added at constant temperature in an ideal \_\_\_\_\_ cycle.**

- (A) Stirling
- (B) Brayton
- (C) Rankine
- (D) None of these

Answer: Option A

**326. What is the degree of freedom for two miscible (non-reacting) substances in vapor-liquid equilibrium forming an azeotrope?**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option C

**327. Heat evolved/absorbed during conversion of a substance from one allotropic form to another is termed as the heat of**

- (A) Fusion
  - (B) Vaporisation
  - (C) Transition
  - (D) None of these
- Answer: Option C

**328. For any system, what is the minimum number of degrees of freedom?**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option A

**329. Solubility of a substance which dissolves with an increase in volume and liberation of heat will be favoured by the**

- (A) Low pressure and high temperature
- (B) Low pressure and low temperature
- (C) High pressure and low temperature
- (D) High pressure and high temperature

Answer: Option B

**330. At the critical point of a substance**

- (A) The surface tension vanishes
- (B) Liquid and vapour have the same density
- (C) There is no distinction between liquid and vapour phases
- (D) All (A), (B) and (C)

Answer: Option D

**331. Which of the following has the least thermal efficiency?**

- (A) Steam engine
- (B) Carnot engine
- (C) Diesel engine
- (D) Otto engine

Answer: Option A

**332. The number of degrees of freedom for an azeotropic mixture in a two component vapour-liquid equilibria is/are**

- (A) Zero
- (B) One
- (C) Two
- (D) Three

Answer: Option B

**333. The point at which all the three (solid, liquid and gas) phases co-exist, is known as the \_\_\_\_\_ point.**

- (A) Freezing
- (B) Triple
- (C) Boiling
- (D) Boyle

Answer: Option B

**334. The freezing point of a liquid decreases when the pressure is increased, if the liquid \_\_\_\_\_ while freezing.**

- (A) Contracts
- (B) Expands
- (C) Does not change in volume
- (D) Either (A), (B) or (C)

Answer: Option A

**335. Specific volume of an ideal gas is**

- (A) Equal to its density
- (B) The reciprocal of its density

- (C) Proportional to pressure
  - (D) None of these
- Answer: Option B

**336. The compressibility factor of a gas is given by (where,  $V_1$  = actual volume of the gas  $V_2$  = gas volume predicted by ideal gas law)**

- (A)  $V_1/V_2$
- (B)  $V_2/V_1$
- (C)  $V_1 - V_2$
- (D)  $V_1 \cdot V_2$

Answer: Option A

**337. Dryness fraction of wet steam is defined as the ratio of mass of vapour in the mixture to the mass of mixture \_\_\_\_\_ calorimeter is not used for measuring the dryness fraction of steam.**

- (A) Bomb
- (B) Separating
- (C) Bucket
- (D) Throttling

Answer: Option A

**338. Molar heat capacity of water in equilibrium with ice at constant pressure is \_\_\_\_\_ Kcal/kg mole. °K**

- (A) 0
- (B)  $\infty$
- (C) 50
- (D) 100

Answer: Option B

**339. The co-efficient of performance (COP) of a refrigerating system, which is its index of performance, is defined as the ratio of useful refrigeration to the net work. The units of \_\_\_\_\_ and COP are the same.**

- (A) Kinematic viscosity
- (B) Work
- (C) Temperature
- (D) None of these

Answer: Option D

**340. In any spontaneous process, the \_\_\_\_\_ free energy decreases.**

- (A) Helmholtz
- (B) Gibbs
- (C) Both 'a' & 'b'
- (D) Neither 'a' nor 'b'

Answer: Option C

**341. The specific heat of saturated water vapour at 100°C is**

- (A)  $\infty$
- (B) -ve
- (C) 0
- (D) +ve

Answer: Option B

**342. An isentropic process is carried out at constant**

- (A) Volume
- (B) Pressure
- (C) Temperature
- (D) All (A), (B) and (C)

Answer: Option A

**343. At 60° C, vapour pressure of methanol and water are 84.562 kPa and 19.953 kPa respectively. An aqueous solution of methanol at 60° C exerts a pressure of 39.223 kPa; the liquid phase and vapour phase mole fractions of methanol are 0.1686 and 0.5714 respectively. Activity co-efficient of methanol is**

- (A) 1.572
- (B) 1.9398



- (C) 3.389  
(D) 4.238  
Answer: Option A

**344. Entropy is a measure of the \_\_\_\_\_ of a system.**

- (A) Disorder  
(B) Orderly behaviour  
(C) Temperature changes only  
(D) None of these  
Answer: Option A

**345. What is the value of Joule-Thomson co-efficient for an ideal gas?**

- (A) +ve  
(B) -ve  
(C) 0  
(D)  $\infty$   
Answer: Option C

**346. If the heat of solution of an ideal gas in a liquid is negative, then its solubility at a given partial pressure varies with the temperature as**

- (A) Solubility increases as temperature increases  
(B) Solubility increases as temperature decreases  
(C) Solubility is independent of temperature  
(D) Solubility increases or decreases with temperature depending on the Gibbs free energy change of solution  
Answer: Option B

**347. If atmospheric temperature and dew point are nearly equal, then the relative humidity is**

- (A) Zero  
(B) 50%  
(C) Almost 100%  
(D) unpredictable  
Answer: Option C

**348. Consider the reaction,  $C + O_2 \rightleftharpoons CO_2$ ;  $\Delta H = -94$  kcal. What will be the value of  $\Delta H$  for the reaction  $CO_2 \rightarrow C + O_2$ ?**

- (A) -94 kcal  
(B) +94 kcal  
(C) > 94 kcal  
(D) < -94 kcal  
Answer: Option B

**349. No work is done by the system, when a reaction occurs at constant**

- (A) Volume  
(B) Temperature  
(C) Pressure  
(D) None of these  
Answer: Option A

**350. Gibbs free energy at constant pressure and temperature under equilibrium conditions is**

- (A)  $\infty$   
(B) 0  
(C) Maximum  
(D) Minimum  
Answer: Option D

**351. Joule-Thomson Co-efficient at any point on the inversion curve is**

- (A)  $\infty$   
(B) +ve  
(C) 0  
(D) -ve  
Answer: Option C

**352. The ammonia synthesis reaction represented by  $N_2 + 3H_2 \rightleftharpoons 2NH_3$ ;  $\Delta H = -22.4$  kcal, is**

- (A) Endothermic

- (B) Exothermic
  - (C) Isothermal
  - (D) Adiabatic
- Answer: Option B

**353. At absolute zero temperature, the \_\_\_\_\_ of the gas is zero.**

- (A) Pressure
  - (B) Volume
  - (C) Mass
  - (D) None of these
- Answer: Option B

**354. In a reversible chemical reaction (where,  $\Delta x$  = number of moles of products-number of moles of reactants)**

- (A) Addition of inert gas favours the forward reaction, when  $\Delta x$  is positive
  - (B) Pressure has no effect on equilibrium, when  $\Delta n = 0$
  - (C) Addition of inert gas has no effect on the equilibrium constant at constant volume for any value of  $\Delta x$  (+ ve, - ve) or zero)
  - (D) All 'a', 'b' & 'c'
- Answer: Option D

**355. For a constant volume process**

- (A)  $dE = C_p dT$
  - (B)  $dE = C_v dT$
  - (C)  $dQ = dE + pdV$
  - (D)  $dW = pdV$
- Answer: Option B

**356. The quantitative effect of temperature on chemical equilibrium is given by the**

- (A) Van't-Hoff equation
  - (B) Le-Chatelier's principle
  - (C) Arrhenius equation
  - (D) None of these
- Answer: Option A

**357. Entropy change in case of reversible adiabatic process is**

- (A) Minimum
  - (B) Zero
  - (C) Maximum
  - (D) Indeterminate
- Answer: Option B

**358. Which is a state function?**

- (A) Specific volume
  - (B) Work
  - (C) Pressure
  - (D) Temperature
- Answer: Option B

**359. Fundamental principle of refrigeration is based on the \_\_\_\_\_ law of thermodynamics.**

- (A) Zeroth
  - (B) First
  - (C) Second
  - (D) Third
- Answer: Option C

**360. Gibbs free energy of a pure fluid approaches \_\_\_\_\_ as the pressure tends to zero at constant temperature.**

- (A) Infinity
  - (B) Minus infinity
  - (C) Zero
  - (D) None of these
- Answer: Option B

**361. Number of components (C), phase (P) and degrees of freedom (F) are related by Gibbs phase rule as**

(A)  $P + F - C = 2$

(B)  $C = P - F + 2$

(C)  $F = C - P - 2$

(D)  $P = F - C - 2$

Answer: Option A

**362. Degree of freedom of a system consisting of a gaseous mixture of H<sub>2</sub> and NH<sub>3</sub> will be**

(A) 0

(B) 1

(C) 2

(D) 3

Answer: Option D

**363. Gases are cooled in Joule-Thomson expansion, when it is \_\_\_\_\_ inversion temperature.**

(A) Below

(B) At

(C) Above

(D) Either 'b' or 'c'

Answer: Option A

**364. Joule-Thomson experiment is**

(A) Isobaric

(B) Adiabatic

(C) Isenthalpic

(D) Both (B) & (C)

Answer: Option D

**365. The amount of heat required to decompose a compound into its elements is \_\_\_\_\_ the heat of formation of that compound from its elements.**

(A) Less than

(B) More than

(C) Same as

(D) Not related to

Answer: Option C

**366. The following heat engine produces power of 100,000 kW. The heat engine operates between 800 K and 300 K. It has a thermal efficiency equal to 50% of that of the Carnot engine for the same temperature. The rate at which heat is absorbed from the hot reservoir is**

(A) 100,000 kW

(B) 160,000 kW

(C) 200,000 kW

(D) 320,000 kW

Answer: Option D

**367. In reactions involving solids and liquids (where change in volume is negligible), the heat of reaction at constant pressure as compared to that at constant volume is**

(A) More

(B) Less

(C) Same

(D) Unpredictable; depends on the particular reaction

Answer: Option C

**368. The standard state of a gas (at a given temperature) is the state in which fugacity is equal to**

(A) Unity

(B) Activity

(C) Both (A) & (B)

(D) Neither (A) nor (B)

Answer: Option C

**369. Which of the following is a thermodynamic property of a system?**

(A) Concentration

(B) Mass

- (C) Temperature
  - (D) Entropy
- Answer: Option D

**370. As the entropy of the universe is increasing, day by day, the work producing capacity of a heat engine is**

- (A) Not changed
  - (B) Decreasing
  - (C) Increasing
  - (D) Data sufficient, can't be predicted
- Answer: Option B

**371. As the temperature is lowered towards the absolute zero, the value of  $\partial(\Delta F)/\partial T$ , then approaches**

- (A) Unity
  - (B) Zero
  - (C) That of the heat of reaction
  - (D) Infinity
- Answer: Option B

**372. Fugacity co-efficient of a substance is the ratio of its fugacity to**

- (A) Mole fraction
  - (B) Activity
  - (C) Pressure
  - (D) Activity co-efficient
- Answer: Option C

**373.  $PV^\gamma = \text{constant}$ , holds good for an isentropic process, which is**

- (A) Reversible and isothermal
  - (B) Isothermal and irreversible
  - (C) Reversible and adiabatic
  - (D) Adiabatic and irreversible
- Answer: Option C

**374. A refrigeration cycle is a reversed heat engine. Which of the following has the maximum value of the co-efficient of performance (COP) for a given refrigeration effect?**

- (A) Vapor compression cycle using expansion valve
  - (B) Air refrigeration cycle
  - (C) Vapor compression cycle using expansion engine
  - (D) Carnot refrigeration cycle
- Answer: Option D

**375. With increase in pressure (above atmospheric pressure), the  $C_p$  of a gas**

- (A) Increases
  - (B) Decreases
  - (C) Remains unchanged
  - (D) First decreases and then increases
- Answer: Option A

**376. For a multi-component system, the term chemical potential is equivalent to the**

- (A) Molal concentration difference
  - (B) Molar free energy
  - (C) Partial molar free energy
  - (D) Molar free energy change
- Answer: Option C

**377. The efficiency of an Otto engine compared to that of a diesel engine, for the same compression ratio will be**

- (A) More
  - (B) Less
  - (C) Same
  - (D) Data insufficient to predict
- Answer: Option A

**378. Which of the following behaves most closely like an ideal gas?**

- (A) He
- (B) N<sub>2</sub>
- (C) O<sub>2</sub>
- (D) H<sub>2</sub>

Answer: Option A

**379. Boyle's law for gases states that**

- (A)  $P \propto 1/V$ , when temperature is constant
- (B)  $P \propto 1/V$ , when temperature & mass of the gas remain constant
- (C)  $P \propto V$ , at constant temperature & mass of the gas
- (D)  $P/V = \text{constant}$ , for any gas

Answer: Option B

**380. The total change in the enthalpy of a system is independent of the**

- (A) Number of intermediate chemical reactions involved
- (B) Pressure and temperature
- (C) State of combination and aggregation in the beginning and at the end of the reaction
- (D) None of these

Answer: Option A

**381. Those solutions in which there is no volume change upon mixing the components in the liquid state and which, when diluted do not undergo any heat change (i.e. heat of dilution is zero), are called \_\_\_\_\_ solutions.**

- (A) Ideal
- (B) Real
- (C) Isotonic
- (D) None of these

Answer: Option A

**382. With increase in temperature, the atomic heat capacities of all solid elements**

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) Decreases linearly

Answer: Option A

**383. A system in which there is exchange of energy but not of mass, is called a/an \_\_\_\_\_ system.**

- (A) Isolated
- (B) Open
- (C) Insulated
- (D) Closed

Answer: Option D

**384. Out of the following refrigeration cycles, which one has the minimum COP (Co-efficient of performance)?**

- (A) Air cycle
- (B) Carnot cycle
- (C) Ordinary vapour compression cycle
- (D) Vapour compression with a reversible expansion engine

Answer: Option A

**385. In a reversible process**

- (A)  $Tds = dE + dW$
- (B)  $dE - dW = Tds$
- (C)  $dW - dE = Tds$
- (D)  $Tds - dW + dE > 0$

Answer: Option A

**386. For an irreversible process involving only pressure-volume work**

- (A)  $(dF)_T, p < 0$
- (B)  $(dF)_T, p = 0$
- (C)  $(dF)_T, p > 0$
- (D)  $(dA)_T, v > 0$

Answer: Option A

**387. Isotherm on an enthalpy-concentration diagram, for an ideal solution will be a**

- (A) Straight line
- (B) Sine curve
- (C) Parabola
- (D) Hyperbola

Answer: Option A

**388. Degrees of freedom at triple point will be**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option A

**389. Number of phases in a colloidal system is:**

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Answer: Option B

**390. Free energy**

- (A) Decreases in all spontaneous (or irreversible) processes
- (B) Change during a spontaneous process has a negative value
- (C) Remains unchanged in reversible processes carried at constant temperature and pressure
- (D) All (A), (B) and (C)

Answer: Option D

**391. What happens in a reversible adiabatic expansion process?**

- (A) Heating takes place
- (B) Cooling takes place
- (C) Pressure is constant
- (D) Temperature is constant

Answer: Option B

**392. Keeping the pressure constant, to double the volume of a given mass of an ideal gas at 27°C, the temperature should be raised to \_\_\_\_\_ °C.**

- (A) 270
- (B) 327
- (C) 300
- (D) 540

Answer: Option B

**393. Free energy changes for two reaction mechanism 'X' and 'Y' are respectively - 15 and - 5 units. It implies that 'X' is**

- (A) Slower than Y
- (B) Faster than Y
- (C) Three times slower than Y
- (D) Three times faster than Y

Answer: Option B

**394. The change in Gibbs free energy for vaporisation of a pure substance is**

- (A) Positive
- (B) Negative
- (C) Zero
- (D) May be positive or negative

Answer: Option C

**395. The effect of changing the evaporator temperature on COP as compared to that of changing the condenser temperature (in vapour compression refrigeration system) is**

- (A) Less pronounced
- (B) More pronounced
- (C) Equal
- (D) Data insufficient, can't be predicted

Answer: Option B

**396. In any spontaneous process,**

- (A) Only  $F$  decreases
- (B) Only  $A$  decreases
- (C) Both  $F$  and  $A$  decrease
- (D) Both  $F$  and  $A$  increase

Answer: Option C

**397. Entropy change of the reaction,  $\text{H}_2\text{O}(\text{liquid}) \rightarrow \text{H}_2\text{O}(\text{gas})$ , is termed as the enthalpy of**

- (A) Solution
- (B) Vaporisation
- (C) Formation
- (D) Sublimation

Answer: Option B

**398. The partial pressure of each constituent present in an alloy is \_\_\_\_\_ the total vapor pressure exerted by the alloy.**

- (A) Less than
- (B) Equal to
- (C) More than
- (D) Either (B) or (C); depends on the type of alloy

Answer: Option A

**399. Free energy, fugacity and activity co-efficient are all affected by change in the temperature. The fugacity co-efficient of a gas at constant pressure \_\_\_\_ with the increase of reduced temperature.**

- (A) Decreases
- (B) Increases
- (C) Remains constant
- (D) Decreases logarithmically

Answer: Option B

**400. In which of the following reaction equilibrium, the value of equilibrium constant  $K_p$  will be more than is  $K_c$ ?**

- (A)  $2\text{HI} \rightleftharpoons \text{H}_2 + \text{I}_2$
- (B)  $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$
- (C)  $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$
- (D) None of these

Answer: Option B

**401. The principle applied in liquefaction of gases is**

- (A) Adiabatic expansion
- (B) Joule-Thomson effect
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

**402. Pick out the wrong statement.**

- (A) Surface tension of a substance vanishes at critical point, as there is no distinction between liquid and vapour phases at its critical point
- (B) Entropy of a system decreases with the evolution of heat
- (C) Change of internal energy is negative for exothermic reactions
- (D) The eccentric factor for all materials is always more than one

Answer: Option D

**403. On opening the door of an operating refrigerator kept in a closed room, the temperature of the room will**

- (A) Increase
- (B) Decrease
- (C) Remain same
- (D) Increase in summer and will decrease in winter

Answer: Option A

**404. In case of steady flow compression polytropic process ( $PV^n = \text{constant}$ ), the work done on air is the lowest, when**

- (A)  $n = \gamma = 1.4$
- (B)  $n = 0$
- (C)  $n = 1$
- (D)  $n = 1.66$

Answer: Option C

**405. \_\_\_\_\_ law of thermodynamics ascertains the direction of a particular spontaneous process.**

- (A) Zeroth
- (B) First
- (C) Second
- (D) Third

Answer: Option C

**406. A/an \_\_\_\_\_ system is exemplified by a vessel containing a volatile liquid in contact with its vapor.**

- (A) Isolated
- (B) Closed
- (C) Open
- (D) None of these

Answer: Option C

**407. Pick out the correct statement.**

- (A) If an insoluble gas is passed through a volatile liquid placed in a perfectly insulated container, the temperature of the liquid will increase
- (B) A process is irreversible as long as  $\Delta S$  for the system is greater than zero
- (C) The mechanical work done by a system is always equal to  $\int P.dV$
- (D) The heat of formation of a compound is defined as the heat of reaction leading to the formation of the compound from its reactants

Answer: Option D

**408. Which of the following is a widely used refrigerant in vapour compression refrigeration system (using large centrifugal compressor)?**

- (A) Freon
- (B) Liquid sulphur dioxide
- (C) Methyl chloride
- (D) Ammonia

Answer: Option A

**409. Entropy change for an irreversible isolated system is**

- (A)  $\infty$
- (B) 0
- (C)  $< 0$
- (D)  $> 0$

Answer: Option D

**410.  $(\partial E/\partial T)_V$  is the mathematical expression for**

- (A)  $C_V$
- (B) Enthalpy change
- (C) Free energy change
- (D) None of these

Answer: Option D

**411. The work done in an adiabatic change in a particular gas depends upon changes in the \_\_\_\_\_ only.**

- (A) Temperature
- (B) Specific heat
- (C) Volume
- (D) Pressure

Answer: Option A

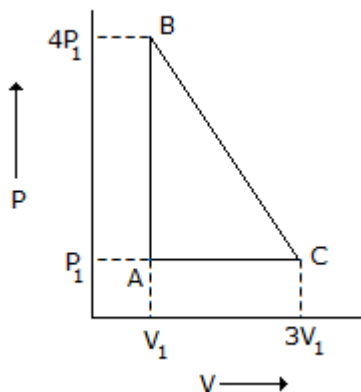


412. Fugacity of a component in an ideal gas mixture is equal to the partial pressure of that component in the mixture. The fugacity of each component in a stable homogeneous solution at constant pressure and temperature \_\_\_\_\_ as its mole fraction increases.

- (A) Decreases
- (B) Decreases exponentially
- (C) Increases
- (D) Remain constant

Answer: Option C

413. An ideal gas is taken around the cycle ABCA as shown in  $P$ - $V$  diagram below: The work done by the gas during the cycle is equal to



- (A)  $12 P_1 V_1$
- (B)  $6 P_1 V_1$
- (C)  $3 P_1 V_1$
- (D)  $P_1 V_1$

Answer: Option C

414. Which of the following is not a unit of the equilibrium constant  $K_p$ ? (where,  $\Delta x$  = number of moles of products number of moles of reactants)

- (A)  $(\text{atm})^{\Delta x}$ , when  $\Delta x$  is negative
- (B)  $(\text{atm})^{\Delta x}$ , when  $\Delta x$  is positive
- (C) Dimensionless, when  $\Delta x = 0$
- (D)  $(\text{atm})^{\Delta x^2}$ , when  $\Delta x > 0$

Answer: Option D

415. The efficiency of a Carnot heat engine operating between absolute temperatures  $T_1$  and  $T_2$  (when,  $T_1 > T_2$ ) is given by  $(T_1 - T_2)/T_1$ . The co-efficient of performance (C.O.P.) of a Carnot heat pump operating between  $T_1$  and  $T_2$  is given by

- (A)  $T_1/(T_1 - T_2)$
- (B)  $T_2/(T_1 - T_2)$
- (C)  $T_1/T_2$
- (D)  $T_2/R_1$

Answer: Option A

416.  $dW$  and  $dq$  are not the exact differential, because  $q$  and  $W$  are

- (A) State functions
- (B) Path functions
- (C) Intensive properties
- (D) Extensive properties

Answer: Option B

417. In an irreversible process

- (A)  $Tds = dE - dW = 0$
- (B)  $dE - dW - Tds = 0$
- (C)  $Tds - dE + dW < 0$
- (D)  $Tds - dT + dW < 0$

Answer: Option C

418. The expression for entropy change given by,  $\Delta S = -nR \ln (P_2/P_1)$ , holds good for

- (A) Expansion of a real gas
- (B) Reversible isothermal volume change
- (C) Heating of an ideal gas

(D) Cooling of a real gas

Answer: Option B

**419. When pressure is applied on the system, ice  $\leftrightarrow$  water, then**

(A) Equilibrium cannot be established

(B) More ice will be formed

(C) More water will be formed

(D) Evaporation of water will take place

Answer: Option C

**420.  $PV^\gamma = \text{Constant}$  (where,  $\gamma = C_p/C_v$ ) is valid for a/an \_\_\_\_\_ process.**

(A) Isothermal

(B) Isentropic

(C) Isobaric

(D) Adiabatic

Answer: Option D

**421. For a constant pressure reversible process, the enthalpy change ( $\Delta H$ ) of the system is**

(A)  $C_v \cdot dT$

(B)  $C_p \cdot dT$

(C)  $\int C_p \cdot dT$

(D)  $\int C_v \cdot dT$

Answer: Option C

**422. Heat is added at constant pressure in an ideal \_\_\_\_\_ cycle.**

(A) Stirling

(B) Brayton

(C) Rankine

(D) Both (B) and (C)

Answer: Option D

**423. Work done is a**

(A) Property of the system

(B) Path function

(C) Point function

(D) State description of a system

Answer: Option B

**424. For the reversible exothermic reaction,  $N_2 + 3H_2 \rightleftharpoons 2NH_3$ , increase of pressure would**

(A) Shift the equilibrium towards right

(B) Give higher yield of  $NH_3$

(C) Both (B) and (C)

(D) Neither (A) nor (B)

Answer: Option C

**425. Co-efficient of performance for a reversed Carnot cycle working between temperatures  $T_1$  and  $T_2$  ( $T_1 > T_2$ ) is**

(A)  $T_2/(T_1 - T_2)$

(B)  $T_1/(T_1 - T_2)$

(C)  $(T_1 - T_2)/T_1$

(D)  $(T_1 - T_2)/T_2$

Answer: Option A

**426. The free energy change for a chemical reaction is given by (where,  $K$  = equilibrium constant)**

(A)  $RT \ln K$

(B)  $-RT \ln K$

(C)  $-R \ln K$

(D)  $T \ln K$

Answer: Option B

**427. After throttling, gas temperature**

(A) Decreases

(B) Increases

(C) Remain same

(D) May increase or decrease; depends on the nature of the gas

Answer: Option A

**428. For a real gas, the chemical potential is given by**

(A)  $RT d \ln P$

(B)  $RT d \ln f$

(C)  $R d \ln f$

(D) None of these

Answer: Option B

**429. If the molar heat capacities ( $C_p$  or  $C_v$ ) of the reactants and products of a chemical reaction are identical, then, with the increase in temperature, the heat of reaction will**

(A) Increase

(B) Decrease

(C) Remain unaltered

(D) Increase or decrease; depends on the particular reaction

Answer: Option C

**430. Minimum number of phases that exists in a system is 1. Number of chemical species in a colloidal system is**

(A) 1

(B) 2

(C) 3

(D) 4

Answer: Option B

**431. The thermodynamic law,  $PV^\gamma = \text{constant}$ , is not applicable in case of**

(A) Ideal compression of air

(B) Free expansion of an ideal gas

(C) Adiabatic expansion of steam in a turbine

(D) Adiabatic compression of a perfect gas

Answer: Option B

**432. The expression for entropy change,  $\Delta S = n C_p \cdot \ln (T_2/T_1)$ , is valid for the \_\_\_\_\_ of a substance.**

(A) Simultaneous pressure & temperature change

(B) Heating

(C) Cooling

(D) Both (B) and (C)

Answer: Option D

**433. For an ideal gas, the chemical potential is given by**

(A)  $RT d \ln P$

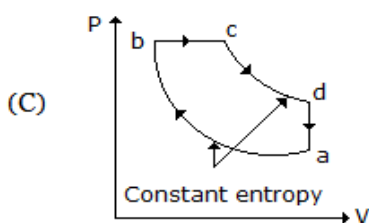
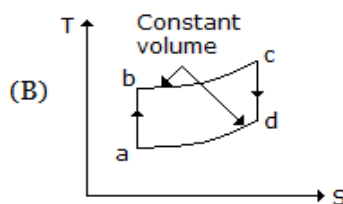
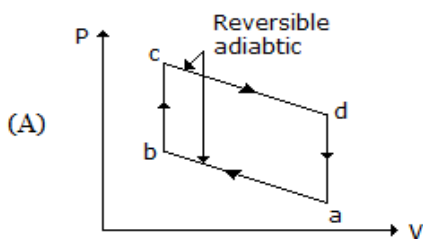
(B)  $R d \ln P$

(C)  $R d \ln f$

(D) None of these

Answer: Option A

**434. Which of the following diagrams does not represent an Otto cycle?**



(D) None of these

Answer: Option C

**435. Internal energy is equal to the heat absorbed in case of a/an \_\_\_\_\_ process.**

- (A) Constant volume
- (B) Polytropic
- (C) Adiabatic
- (D) Constant pressure

Answer: Option A

**436. Heat requirement for decomposition of a compound into its elements is \_\_\_\_\_ that is evolved during the formation of that compound from its elements.**

- (A) The same
- (B) Less than
- (C) Greater than
- (D) Different than

Answer: Option A

**437. Specific heat of a gas for a reversible adiabatic process is**

- (A) Negative
- (B) Zero
- (C) Infinity
- (D) None of these

Answer: Option B

**438. Specific/molar Gibbs free energy for a pure substance does not change during**

- (A) Sublimation
- (B) Vaporisation
- (C) Melting
- (D) Either (A), (B) or (C)

Answer: Option D

**439. Pick out the correct statement.**

- (A) The available energy in an isolated system for all irreversible (real) processes decreases
- (B) The efficiency of a Carnot engine increases, if the sink temperature is decreased
- (C) The reversible work for compression in non-flow process under isothermal condition is the change in Helmholtz free energy
- (D) All (A), (B) and (C)

Answer: Option D

**440. 4 kg moles of an ideal gas expands in vacuum spontaneously. The work done is**

- (A) 4 J
- (B)  $\infty$
- (C) 0
- (D) 8 J

Answer: Option C

**441. The Maxwell relation derived from the differential expression for the Helmholtz free energy ( $dA$ ) is**

- (A)  $(\partial T/\partial V)_S = -(\partial P/\partial S)_V$
- (B)  $(\partial S/\partial P)_T = -(\partial V/\partial T)_P$
- (C)  $(\partial V/\partial S)_P = (\partial T/\partial P)_S$
- (D)  $(\partial S/\partial V)_T = (\partial P/\partial T)_V$

Answer: Option D

**442. One ton of refrigeration is defined as the heat rate corresponding to melting of one ton of ice in one**

- (A) Hour
- (B) Day
- (C) Minute
- (D) Second

Answer: Option B

**443. A gas shows deviation from ideal behaviour at**

- (A) Low pressure and high temperature
- (B) Low pressure and low temperature
- (C) Low temperature and high pressure

(D) High temperature and high pressure

Answer: Option C

**444. A solid metallic block weighing 5 kg has an initial temperature of 500°C. 40 kg of water initially at 25°C is contained in a perfectly insulated tank. The metallic block is brought into contact with water. Both of them come to equilibrium. Specific heat of block material is 0.4 kJ.kg<sup>-1</sup>. K<sup>-1</sup>. Ignoring the effect of expansion and contraction and also the heat capacity to tank, the total entropy change in kJ.kg<sup>-1</sup>, K<sup>-1</sup> is**

(A) -1.87

(B) 0

(C) 1.26

(D) 3.91

Answer: Option B

**445. Entropy of the system decreases, when**

(A) Snow melts into water

(B) A gas expands spontaneously from high pressure to low pressure

(C) Water is converted into ice

(D) Both (B) & (C)

Answer: Option D

**446. In the reaction, H<sub>2</sub> + I<sub>2</sub> ⇌ 2HI, addition of an inert gas will**

(A) Increase the partial pressure of H<sub>2</sub>

(B) Increase the partial pressure of I<sub>2</sub>

(C) Increase the total pressure and hence shift the equilibrium towards the right

(D) Not affect the equilibrium conditions

Answer: Option D

**447. It is desired to bring about a certain change in the state of a system by performing work on the system under adiabatic conditions.**

(A) The amount of work needed is path dependent

(B) Work alone cannot bring out such a change of state

(C) The amount of work needed is independent of path

(D) More information is needed to conclude anything about the path dependence or otherwise of the work needed

Answer: Option A

**448. Partial molar free energy of an element A in solution is same as its**

(A) Chemical potential

(B) Activity

(C) Fugacity

(D) Activity co-efficient

Answer: Option A

**449. Translational kinetic energy of molecules of an ideal gas is proportional to (where, T = absolute temperature of the gas)**

(A) T

(B)  $\sqrt{T}$

(C) T<sup>2</sup>

(D) 1/ $\sqrt{T}$

Answer: Option A

**450. Which of the following has the minimum value of COP for a given refrigeration effect?**

(A) Reverse Carnot cycle

(B) Ordinary vapour-compression cycle

(C) Vapour-compression process with a reversible expansion engine

(D) Air refrigeration cycle

Answer: Option D

**451. The four properties of a system viz. P, V, T, S are related by \_\_\_\_\_ equation.**

(A) Gibbs-Duhem

(B) Gibbs-Helmholtz

(C) Maxwell's

(D) None of these

Answer: Option C

**452. The expression,  $nC_v(T_2 - T_1)$ , is for the \_\_\_\_\_ of an ideal gas.**

- (A) Work done under adiabatic condition
- (B) Co-efficient of thermal expansion
- (C) Compressibility
- (D) None of these

Answer: Option A

**453. Clausius-Clapeyron equation is applicable to \_\_\_\_\_ equilibrium processes.**

- (A) Solid-vapor
- (B) Solid-liquid
- (C) Liquid-vapor
- (D) All (A), (B) and (C)

Answer: Option D

**454.  $(1/V)(\partial V/\partial T)_P$  is the mathematical expression**

- (A) Joule-Thomson co-efficient
- (B) Specific heat at constant pressure ( $C_p$ )
- (C) co-efficient of thermal expansion
- (D) Specific heat at constant volume ( $C_v$ )

Answer: Option C

**455. During the phase transition, \_\_\_\_\_ changes.**

- (A) Pressure
- (B) Volume
- (C) Temperature
- (D) All (A), (B) and (C)

Answer: Option B

**456. Domestic refrigerator usually works on the \_\_\_\_\_ refrigeration cycle.**

- (A) Carnot
- (B) Air
- (C) Absorption
- (D) vapour-ejection

Answer: Option C

**457. The activity of an ideal gas is numerically \_\_\_\_\_ its pressure.**

- (A) More than
- (B) Less than
- (C) Equal to
- (D) Data insufficient, can't be predicted

Answer: Option C

**458. \_\_\_\_\_ functions are exemplified by heat and work.**

- (A) Path
- (B) Point
- (C) State
- (D) None of these

Answer: Option A

**459. Two substances are in equilibrium in a reversible chemical reaction. If the concentration of each substance is doubled, then the value of the equilibrium constant will be**

- (A) Same
- (B) Doubled
- (C) Halved
- (D) One fourth of its original value

Answer: Option A

**460. Chemical potential is a/an**

- (A) Extensive property
- (B) Intensive property
- (C) Force which drives the chemical system to equilibrium
- (D) Both (B) and (C)

Answer: Option D

**461. Claude gas liquefaction process employs cooling**

- (A) At constant pressure
- (B) By throttling
- (C) By expansion in an engine
- (D) None of these

Answer: Option C

**462. In the reaction, represented by,  $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ ;  $\Delta H = -42$  kcal; the forward reaction will be favoured by**

- (A) Low temperature
- (B) High pressure
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

**463. Co-efficient of Performance (COP) of a refrigerator is the ratio of the**

- (A) Work required to refrigeration obtained
- (B) Refrigeration obtained to the work required
- (C) Lower to higher temperature
- (D) Higher to lower temperature

Answer: Option B

**464. Extensive properties of a thermodynamic system depend upon the \_\_\_\_\_ of the system.**

- (A) Specific volume
- (B) Temperature
- (C) Mass
- (D) Pressure

Answer: Option C

**465. Change of state namely evaporation condensation, freezing and melting is an \_\_\_\_\_ process.**

- (A) Isothermal
- (B) Adiabatic
- (C) Isobaric
- (D) Isochoric

Answer: Option A

**466. Free energy change at equilibrium is**

- (A) Zero
- (B) Positive
- (C) Negative
- (D) Indeterminate

Answer: Option A

**467. First law of thermodynamics is mathematically stated as**

- (A)  $dQ = dE + dW$
- (B)  $dQ = dE - dW$
- (C)  $dE = dQ + dW$
- (D)  $dW = dQ + dE$

Answer: Option A

**468. \_\_\_\_\_ decreases during adiabatic throttling of a perfect gas.**

- (A) Entropy
- (B) Temperature
- (C) Enthalpy
- (D) Pressure

Answer: Option D

**469. Entropy change of mixing two liquid substances depends upon the**

- (A) Molar concentration
- (B) Quantity (i.e. number of moles)
- (C) Both (A) and (B)
- (D) Neither (A) nor (B)

Answer: Option C

**470. The first law of thermodynamics is a restatement of the law of conservation of**

- (A) Mass
- (B) Energy
- (C) Momentum
- (D) None of these

Answer: Option B

**471. Gibbs-Duhem equation**

- (A) States that  $n_1d\mu_1 + n_2d\mu_2 + \dots n_jd\mu_j = 0$ , for a system of definite composition at constant temperature and pressure
- (B) Applies only to binary systems
- (C) Finds no application in gas-liquid equilibria involved in distillation
- (D) None of these

Answer: Option A

**472. A liquid under pressure greater than its vapour pressure for the temperature involved is called a \_\_\_\_\_ liquid.**

- (A) Sub-cooled
- (B) Saturated
- (C) Non-solidifiable
- (D) None of these

Answer: Option A

**473. Number of degrees of freedom for a three phase system in equilibrium comprising of three non-reacting chemical species is**

- (A) 2
- (B) 0
- (C) 1
- (D) 3

Answer: Option A

**474. The unit of equilibrium constant of a chemical reaction is the same as that of**

- (A) Molar concentration
- (B) Temperature
- (C) Internal energy
- (D) None of these

Answer: Option D

**475. What is the value of maximum COP in case of absorption refrigeration, if refrigeration provided is at temperature,  $T_R$  (where,  $T_1$  and  $T_2$  are source & surrounding temperatures respectively.)?**

- (A)  $T_R/(T_2 - T_R) \times (T_1 - T_2)/T_1$
- (B)  $T_R/(T_2 - T_R) \times T_1/(T_1 - T_2)$
- (C)  $T_R/(T_1 - T_R) \times (T_1 - T_2)/T_1$
- (D) None of these

Answer: Option A

**476. The entropy change in a reversible isothermal process, when an ideal gas expands to four times its initial volume is**

- (A)  $R \log_e 4$
- (B)  $R \log_{10} 4$
- (C)  $C_v \log_{10} 4$
- (D)  $C_v \log_e 4$

Answer: Option A

**477. Throttling (Joule-Thomson effect) process is a constant \_\_\_\_\_ process.**

- (A) Enthalpy
- (B) Entropy
- (C) Pressure
- (D) None of these

Answer: Option A

**478.  $(\partial H/\partial T)_P$  is the mathematical expression for**

- (A)  $C_V$



- (B) Entropy change
  - (C) Gibbs free energy
  - (D) None of these
- Answer: Option D

**479. The equation  $Tds = dE - PdV$  applies to**

- (A) Single phase fluid of varying composition
- (B) Single phase fluid of constant composition
- (C) Open as well as closed systems
- (D) Both (B) and (C)

Answer: Option D

**480. With increase in temperature, the internal energy of a substance**

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) May increase or decrease; depends on the substance

Answer: Option A

**481. Heat pump**

- (A) Accomplishes only space heating in winter
- (B) Accomplishes only space cooling in summer
- (C) Accomplishes both (A) and (B)
- (D) Works on Carnot cycle

Answer: Option C

**482. All gases above its inversion temperature, in a throttling process will show**

- (A) A heating effect
- (B) No change in temperature
- (C) A cooling effect
- (D) Either (A) or (C)

Answer: Option A

**483. Pick out the wrong statement.**

- (A) Minimum number of degree of freedom of a system is zero
- (B) Degree of freedom of a system containing a gaseous mixture of helium, carbon dioxide and hydrogen is 4
- (C) For a two phase system in equilibrium made up of four non-reacting chemical species, the number of degrees of freedom is 4
- (D) Enthalpy and internal energy change is zero during phase change processes like melting, vaporisation and sublimation

Answer: Option D

**484. If the pressure on 100 c.c. of air is halved, then its volume (at the same temperature) would be \_\_\_\_\_ c.c.**

- (A) 100
- (B) 50
- (C) 205
- (D) 200

Answer: Option D

**485. For an ideal solution, the value of activity co-efficient is**

- (A) 0
- (B) 1
- (C)  $< 1$
- (D)  $> 1$

Answer: Option B

**486. The internal energy of a gas obeying  $P(V - b) = RT$  (where,  $b$  is a positive constant and has a constant  $C_v$ ), depends upon its**

- (A) Pressure
- (B) Volume
- (C) Temperature
- (D) All (A), (B) & (C)

Answer: Option C

**487. Isentropic process means a constant \_\_\_\_\_ process.**

- (A) Enthalpy
- (B) Pressure
- (C) Entropy
- (D) None of these

Answer: Option C

**488. Which of the following equations is obtained on combining 1st and 2nd law of thermodynamics, for a system of constant mass?**

- (A)  $dE = Tds - PdV$
- (B)  $dQ = C_v dT + PdV$
- (C)  $dQ = C_p dT + Vdp$
- (D)  $Tds = dE - PdV$

Answer: Option A

**489. Entropy is a/an**

- (A) State function
- (B) Macroscopic property
- (C) Extensive property
- (D) None of these

Answer: Option D

**490. In polytropic process ( $PV^n = \text{constant}$ ), if  $n = 1$ ; it means a/an \_\_\_\_\_ process.**

- (A) Adiabatic
- (B) Reversible
- (C) Isothermal
- (D) None of these

Answer: Option C

**491. If an ideal solution is formed by mixing two pure liquids in any proportion, then the \_\_\_\_\_ of mixing is zero**

- (A) Enthalpy
- (B) Volume
- (C) Both 'a' & 'b'
- (D) Neither 'a' nor 'b'

Answer: Option C

**492. The difference between isothermal compressibility and adiabatic compressibility for an ideal gas is**

- (A) 0
- (B) +ve
- (C) -ve
- (D)  $\infty$

Answer: Option B

**493. The temperature at which both liquid and gas phases are identical, is called the \_\_\_\_\_ point.**

- (A) Critical
- (B) Triple
- (C) Freezing
- (D) Boiling

Answer: Option A

**494. Clausius-Clapeyron Equation gives accurate result, when the**

- (A) Vapour pressure is relatively low and the temperature does not vary over wide limits
- (B) Vapour obeys the ideal gas law and the latent heat of vaporisation is constant
- (C) Volume in the liquid state is negligible compared with that in the vapour state
- (D) All (A), (B) and (C)

Answer: Option D

**495. Tea kept in a thermos flask is vigorously shaken. If the tea is considered as a system, then its temperature will**

- (A) Increase
- (B) Decrease

- (C) Remain unchanged
  - (D) First fall and then rise
- Answer: Option A

**496. Any substance above its critical temperature exists as**

- (A) Saturated vapour
- (B) Solid
- (C) Gas
- (D) Liquid

Answer: Option C

**497. Joule-Thomson co-efficient for a perfect gas is**

- (A) Zero
- (B) Positive
- (C) Negative
- (D) None of these

Answer: Option A

**498. The number of degrees of freedom for a mixture of ice and water (liquid) are**

- (A) 3
- (B) 2
- (C) 1
- (D) 0

Answer: Option C

**499. Grams of butane ( $C_4H_{10}$ ) formed by the liquefaction of 448 litres of the gas (measured at (STP) would be**

- (A) 580
- (B) 640
- (C) 1160
- (D) Data insufficient; can't be computed

Answer: Option C

**500. Which is not constant for an ideal gas?**

- (A)  $(\partial P/\partial V)_T$
- (B)  $(\partial V/\partial T)_P$
- (C)  $(\partial P/\partial V)_V$
- (D) All (A), (B) & (C)

Answer: Option A

**501. In the ammonia synthesis reaction,  $N_2 + 3H_2 \rightleftharpoons 2NH_3 + 22.4 \text{ kcal}$ , the formation of  $NH_3$  will be favoured by**

- (A) High temperature
- (B) Low pressure
- (C) Low temperature only
- (D) Both low temperature and high pressure

Answer: Option D

**502. Refrigeration capacity of a household refrigerator may be round about \_\_\_\_\_ tons.**

- (A) 0.15
- (B) 1.5
- (C) 4.5
- (D) 6.5

Answer: Option A

**503. What is the number of degree of freedom for a system of two miscible non-reacting species in vapor-liquid equilibrium forming an azeotrope?**

- (A) 0
- (B) 2
- (C) 1
- (D) 3

Answer: Option C

**504. Boiling of liquid is accompanied with increase in the**

- (A) Vapor pressure

- (B) Specific Gibbs free energy
  - (C) Specific entropy
  - (D) All (A), (B) and (C)
- Answer: Option A

**505. What is the value of  $\ln \gamma$  (where  $\gamma$  = activity co-efficient) for ideal gases?**

- (A) Zero
- (B) Unity
- (C) Infinity
- (D) Negative

Answer: Option A

**506. Near their critical temperatures, all gases occupy volumes \_\_\_\_\_ that of the ideal gas.**

- (A) Less than
- (B) Same as
- (C) More than
- (D) Half

Answer: Option A

**507. Change of heat content when one mole of compound is burnt in oxygen at constant pressure is called the**

- (A) Calorific value
- (B) Heat of reaction
- (C) Heat of combustion
- (D) Heat of formation

Answer: Option C

**508. Which of the following decreases with increase in pressure?**

- (A) Melting point of ice
- (B) Melting point of wax
- (C) Boiling point of liquids
- (D) None of these

Answer: Option A

**509. For a single component two phase mixture, the number of independent variable properties are**

- (A) Two
- (B) One
- (C) Zero
- (D) Three

Answer: Option B

**510. The internal energy of an ideal gas does not change in a reversible \_\_\_\_\_ process.**

- (A) Isothermal
- (B) Adiabatic
- (C) Isobaric
- (D) Isometric

Answer: Option A

**511. When a gas in a vessel expands, its internal energy decreases. The process involved is**

- (A) Reversible
- (B) Irreversible
- (C) Isothermal
- (D) Adiabatic

Answer: Option A

**512. In a P-V diagram (for an ideal gas), an isothermal curve will coincide within adiabatic curve (through a point), when**

- (A)  $C_p < C_v$
- (B)  $C_p = C_v$
- (C)  $C_p > C_v$
- (D)  $C \geq C_v$

Answer: Option B

**513. The Joule-Thomson co-efficient is defined as  $(\partial T/\partial P)_H$ . Its value at the inversion point is**

- (A)  $\infty$
- (B) 1
- (C) 0
- (D) -ve

Answer: Option C

**514. The melting point of paraffin wax (which contracts on solidification) \_\_\_\_\_ with pressure rise.**

- (A) Increases
- (B) Decreases
- (C) Remains unchanged
- (D) Decreases linearly

Answer: Option A

**515. Enthalpy ' $H$ ' is defined as**

- (A)  $H = E - PV$
- (B)  $H = F - TS$
- (C)  $H - E = PV$
- (D) None of these

Answer: Option C

**516. Which of the following is not an equation of state?**

- (A) Bertholet equation
- (B) Clausius-Clapeyron equation
- (C) Beattie-Bridgeman equation
- (D) None of these

Answer: Option B

**517. A closed system is cooled reversibly from  $100^{\circ}\text{C}$  to  $50^{\circ}\text{C}$ . If no work is done on the system**

- (A) its internal energy ( $U$ ) decreases and its entropy ( $S$ ) increases
- (B)  $U$  and  $S$  both decreases
- (C)  $U$  decreases but  $S$  is constant
- (D)  $U$  is constant but  $S$  decreases

Answer: Option B

**518. What is the number of degrees of freedom for liquid water in equilibrium with a mixture of nitrogen and water vapor?**

- (A) 2
- (B) 0
- (C) 3
- (D) 1

Answer: Option A

**519. The chemical potential for a pure substance is \_\_\_\_\_ its partial molal free energy.**

- (A) More than
- (B) Less than
- (C) Equal to
- (D) Not related to

Answer: Option C

**520. A system is said to be isopiestic, if there is no \_\_\_\_\_ change.**

- (A) Temperature
- (B) Pressure
- (C) Volume
- (D) None of these

Answer: Option B

**521. The number of degrees of freedom at the triple point of water is**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

Answer: Option A

**522. Maxwell's relation corresponding to the identity,  $dH = dS = Vd_p + \sum \mu_i dn_i$  is**

(A)  $(\partial T/\partial V)_{S,ni} = -(\partial P/\partial S)_{V,ni}$

(B)  $(\partial S/\partial P)_{T,ni} = (\partial V/\partial T)_{P,ni}$

(C)  $(\partial S/\partial V)_{T,ni} = (\partial P/\partial T)_{V,ni}$

(D)  $(\partial T/\partial P)_{S,ni} = (\partial V/\partial S)_{P,ni}$

Answer: Option D

**523. In a turbine, the fluid expands almost**

(A) Isothermally

(B) Isobarically

(C) Adiabatically

(D) None of these

Answer: Option C

**524. Critical solution temperature (or the con-solute temperature) for partially miscible liquids (e.g., phenol-water) is the minimum temperature at which**

(A) A homogeneous solution (say of phenol water) is formed

(B) Mutual solubility of the two liquids shows a decreasing trend

(C) Two liquids are completely separated into two layers

(D) None of these

Answer: Option A

**525. Compressibility factor (i.e., the ratio of actual volume of gas to the volume predicted by ideal gas law) for all gases are**

(A) Always greater than one

(B) Same at the same reduced temperature

(C) Same at the same reduced pressure

(D) Both (B) & (C)

Answer: Option D

**526. Which is not a refrigerant?**

(A)  $\text{SO}_2$

(B)  $\text{NH}_3$

(C)  $\text{CCl}_2\text{F}_2$

(D)  $\text{C}_2\text{H}_4\text{Cl}_2$

Answer: Option D

**527. The temperature at which a real gas obeys the ideal gas laws over a wide range of pressure is called the \_\_\_\_\_ temperature.**

(A) Critical

(B) Boyle

(C) Inversion

(D) Reduced

Answer: Option B

**528. When liquid and vapour phase of multi-component system are in equilibrium (at a given temperature and pressure), then chemical potential of each component is**

(A) Same in both the phases

(B) Zero in both the phases

(C) More in vapour phase

(D) More in liquid phase

Answer: Option A

**529. Mollier diagram is a plot of**

(A) Temperature vs. enthalpy

(B) Temperature vs. enthalpy

(C) Entropy vs. enthalpy

(D) Temperature vs. internal energy

Answer: Option C

**530. The value of gas constant 'R' is**

(A) 1.987 cal/gm mole °K

(B) 1.987 BTU/lb. mole °R

(C) Both (A) and (B)

(D) Neither (A) nor (B)

Answer: Option C

**531. At triple point (for one component system), vapour pressure of solid as compared to that of liquid will be**

- (A) More
- (B) Less
- (C) Same
- (D) More or less; depending on the system

Answer: Option C

**532. The unity of Planck's constant 'h' in the equation,  $E = h\nu$  is**

- (A) J/s
- (B) J.S
- (C) J/kmol
- (D) kmol/J

Answer: Option B

**533. Equation which relates pressure, volume and temperature of a gas is called the**

- (A) Equation of state
- (B) Gibbs Duhem equation
- (C) Ideal gas equation
- (D) None of these

Answer: Option A

**534. COP of a refrigerator drawing 1 kW of power per ton of refrigeration is about**

- (A) 0.5
- (B) 3.5
- (C) 4.5
- (D) 8.5

Answer: Option B

**535. Pick out the wrong statement.**

- (A)  $C_p$  of monatomic gases such as metallic vapor is about 5 kcal/kg.atom
- (B) The heat capacity of solid inorganic substance is exactly equal to the heat capacity of the substance in the molten state
- (C) There is an increase in entropy, when a spontaneous change occurs in an isolated system
- (D) At absolute zero temperature, the heat capacity for many pure crystalline substances is zero

Answer: Option B

**536. In an isothermal process on an ideal gas, the pressure increases by 0.5 percent. The volume decreases by about \_\_\_\_\_ percent.**

- (A) 0.25
- (B) 0.5
- (C) 0.75
- (D) 1

Answer: Option B

**537. Which of the following is not correct for a reversible adiabatic process?**

- (A)  $TV^{\gamma-1} = \text{constant}$
- (B)  $p^{1-\gamma}.T^{\gamma} = \text{constant}$
- (C)  $PV^{\gamma} = \text{constant}$
- (D) None of these

Answer: Option D

**538. Lowering of condenser temperature (keeping the evaporator temperature constant) in case of vapour compression refrigeration system results in**

- (A) Increased COP
- (B) Same COP
- (C) Decreased COP
- (D) Increased or decreased COP; depending upon the type of refrigerant

Answer: Option A

**539. The temperature at which a real gas obeys the ideal gas laws over a wide range of pressure is called \_\_\_\_\_ temperature.**

- (A) Boyle
- (B) Inversion