Thermodynamics

1. A definite area or space where some thermodynamic process takes place is known as
(a) thermodynamic system*
(b) thermodynamic cycle
(c) thermodynamic process
(d) thermodynamic law.

2. An open system is one in which
(a) heat and work cross the boundary of the system, but the mass of the working substance does not
(b) mass of working substance crosses the boundary of the system but the heat and work do not
(c) both the heat and work as well as mass of the working substances cross the boundary of the system*
(d) neither the heat and work nor the mass of the working substances cross the boundary of the system.

3. An isolated system
(a) is a specified region where transfer of energy and/or mass take place
(b) is a region of constant mass and only energy is allowed to cross the boundaries
(c) cannot transfer either energy or mass to or from the surroundings*
(d) is one in which mass within the system is not necessarily constant

4. In an extensive property of a thermodynamic system
(a) extensive heat is transferred
(b) extensive work is done
(c) extensive energy is utilised
(d) none of the above.*

5. Which of the following is an intensive property of a thermodynamic system?
(a) Volume
(b) Temperature*
(c) Mass
(d) Energy.

6. Which of the following is the extensive property of a thermodynamic system ?
(a) Pressure
(b) Volume*
(c) Temperature
(d) Density.

7. When two bodies are in thermal equilibrium with a third body they are also in thermal equilibrium
with each other. This statement is called
(a) Zeroth law of thermodynamics*
(b) First law of thermodynamics
(c) Second law of thermodynamics (d) Kelvin Planck's law.

8. The temperature at which the volume of a gas becomes zero is called
(a) absolute scale of temperature
(b) absolute zero temperature*
(c) absolute temperature
(d) none of the above.

9. The value of one bar (in SI units) is equal to
(a) 100 N/m^2
(b) 1000 N/m^2
(c) 1×10^4 N/m^2
(d) 1×10^5 N/m^2*

10. The absolute zero pressure will be
(a) when molecular momentum of the system becomes zero*
(b) at sea level(c) at the temperature of – 273 K
(d) under vacuum conditions (e) at the centre of the earth.

11. Absolute zero temperature is taken as
(a) – 273°C*
(b) 273°C
(c) 237°C
(d) – 373°C.

12. Which of the following is correct ?

(a) Absolute pressure = gauge pressure + atmospheric pressure*
(b) Gauge pressure = absolute pressure + atmospheric pressure
(c) Atmospheric pressure = absolute pressure + gauge pressure
(d) Absolute pressure = gauge pressure – atmospheric pressure.

13. The unit of energy in SI units is
(a) Joule (J) *
(b) Joule metre (Jm)
(c) Watt (W)
(d) Joule/metre (J/m).

14. One watt is equal to
(a) 1 Nm/s*
(b) 1 N/min
(c) 10 N/s
(d) 100 Nm/s

15. One joule (J) is equal to
(a) 1 Nm*
(b) kNm
(c) 10 Nm/s
(d) 10 kNm/s.

16. The amount of heat required to raise the temperature of 1 kg of water through 1°C is called
(a) specific heat at constant volume (b) specific heat at constant pressure
(c) kilo calorie*
(d) none of the above.

17. The heating and expanding of a gas is called
(a) thermodynamic system
(b) thermodynamic cycle*
(c) thermodynamic process
(d) thermodynamic law.

18. A series of operations, which take place in a certain order and restore the initial condition is known as
(a) reversible cycle
(b) irreversible cycle
(c) thermodynamic cycle*
(d) none of the above.

19. The condition for the reversibility of a cycle is
(a) the pressure and temperature of the working substance must not differ, appreciably, from those of the surroundings at any stage in the process
(b) all the processes, taking place in the cycle of operation, must be extremely slow
(c) the working parts of the engine must be friction free
(d) all of the above*

20. In an irreversible process, there is a
(a) loss of heat*
(b) no loss of heat
(c) gain of heat
(d) no gain of heat.

21. The main cause of the irreversibility is
(a) mechanical and fluid friction
(b) unrestricted expansion
(c) heat transfer with a finite temperature difference
(d) all of the above*

22. According to kinetic theory of heat
(a) temperature should rise during boiling
(b) temperature should fall during freezing
(c) at low temperature all bodies are in solid state
(d) at absolute zero there is absolutely no vibration of molecules*

23. A system comprising a single phase is called a
(a) closed system
(b) open system
(c) isolated system
(d) homogeneous system*

24. A closed system is one, which:
(a) Permits the passage of energy and matter across boundaries
(b) Does not permit the passage of energy and matter across boundaries
(c) Permits the passage of energy but does not permit the passage of matter*
(d) Does not permit the passage of energy but permits the matter

25. An isolated system is one, which:

(a) Permits the passage of energy and matter across boundaries
(b) Permits passage of energy only
(c) Does not permit the passage of energy and matter across boundaries*
(d) Permits the passage of matter only

26. A system comprising of single phase is known as:
(a) Open system
(b) Closed system
(c) Homogeneous system*
(d) Heterogeneous system

27. Control volume refers to:
(a) A specified mass
(b) A fixed region in space*
(c) A closed system
(d) None of the above

28. Specific heat is the amount of heat required to raise the temperature:
(a) By unit degree of a substance
(b) By unit degree of a unit mass*
(c) Of a unit mass by 5°C
(d) None of these

29. Internal energy of a perfect gas depends upon:
(a) Temperature only*
(b) Temperature and pressure
(c) Temperature, pressure and specific heats
(d) None of these

30. For a closed system, the difference between the heat added to the system and work done by the gas is equal to the change in:
(a) Enthalpy
(b) Entropy
(c) Internal energy*
(d) Temperature

31. The properties of the system, whose value for the entire system is equal to the sum of their values for individual parts of the system, are known as:
(a) Thermodynamic properties
(b) Extensive properties*
(c) Intensive properties
(d) None of the above

32. Temperature of a system is:
(a) Thermodynamic properties
(b) Extensive properties
(c) Intensive properties*
(d) None of the above

33. When two bodies are in thermal equilibrium with a third body, they are also in thermal equilibrium with each other:
(a) Zeroth law of thermodynamics*
(b) First law of thermodynamics
(c) Second law of thermodynamics
(d) None of the above

34. The measurement of thermodynamic properties known as temperature is based on:
(a) Zeroth law of thermodynamics*
(b) First law of thermodynamics
(c) Second law of thermodynamics
(d) None of the above

35. Heat and work are mutually convertible. This statement is:
(a) Zeroth law of thermodynamics
(b) First law of thermodynamics*
(c) Second law of thermodynamics
(d) None of the above

36. Second law of thermodynamics defines:
(a) Enthalpy
(b) Entropy*
(c) Heat
(d) Work

37. Kelvin–Planck's law deals with:
(a) Conversion of work into heat
(b) Conversion of heat into work*
(c) Conservation of work
(d) Conservation of heat

38. According to Kelvin–Planck's statement, a perpetual motion machine:
(a) Of first kind is possible
(b) Of first kind is impossible
(c) Of second kind is impossible*
(d) Of second kind is possible

39. A perpetual motion machine of the first kind, i.e., a machine which produces power without consuming any energy is:
(a) Possible according to the first law of thermodynamics
(b) Impossible according to first law of thermodynamics*
(c) Impossible according to second law of thermodynamics
(d) Possible according to second law of thermodynamics

40. Heat flows from cold substance to hot substance with the aid of external work. This statement is given by:
(a) Kelvin
(b) Joule
(c) Gay Lussac
(d) Clausius*

41. Specific heat at constant volume is given by:
(a) $\frac{R}{J(\gamma-1)}$ *
(b) $\frac{\gamma R}{J(\gamma-1)}$
(c) $\frac{R(\gamma-1)}{J}$
(d) $\frac{J(\gamma-1)}{R}$

42. Specific heat at constant pressure is given by:
(a) $\frac{R}{J(\gamma-1)}$
(b) $\frac{\gamma R}{J(\gamma-1)}$ *
(c) $\frac{R(\gamma-1)}{J}$
(d) $\frac{J(\gamma-1)}{R}$

43. The condition for reversibility of a cycle is:
(a) $\oint \frac{dQ}{T} < 0$
(b) $\oint \frac{dQ}{T} > 0$
(c) $\oint \frac{dQ}{T} = 0$ *
(d) None of the above

44. The condition for irreversibility of a cycle is:
(a) $\oint \frac{dQ}{T} < 0$ *
(b) $\oint \frac{dQ}{T} > 0$
(c) $\oint \frac{dQ}{T} = 0$
(d) None of the above

45. $\oint \frac{dQ}{T} > 0$, the cycle is:
(a) Reversible
(b) Irreversible
(c) Impossible*
(d) None of the above

46. Biogas is produced under anaerobic conditions by the fermentation of biological materials. What is the main constituent of biogas?
(a) Butane
(b) Ethane
(c) Methane*
(d) Propane

47. A sample of neon gas occupies a volume of 2.8 l at 1.8 atm. What will its volume be at 1.2 atm?
(a) 1.2 l
(b) 1.8 l
(c) 2.2 l
(d) 4.2 l*

48. The pressure required to compress 48 l of oxygen gas at 99.3 kPa in order to reduce its volume to 16 l is:
(a) 198 kPa
(b) 278 kPa
(c) 298 kPa*

(d) 320 kPa

49. Volume of sulphur dioxide gas at 0.989 atm is 59 ml. What will be its volume at 0.967 atm?
(a) 60.3 ml*
(b) 68 ml
(c) 80 ml
(d) 108 ml

50. A sample of hydrogen gas at 6.5 atm pressure occupies a volume of 2.2 l. What will be its volume at 1.15 atm?
(a) 10 l
(b) 12 l*
(c) 14 l
(d) 16 l

51. A balloon full of air has a volume of 2.75 l at a temperature of 291 K. What will be volume of the balloon at 318 K?
(a) 2.10 l
(b) 3.01 l*
(c) 3.5 l
(d) 4.12 l

52. A sample of argon gas has a volume of 0.43 ml at 297 K. At what temperature will it have a volume of 0.57 ml?
(a) 394 K*
(b) 294 K
(c) 494 K
(d) 194 K

53. When the atmospheric pressure is increased on a balloon, the volume of the balloon will:
(a) Increase
(b) Decrease*
(c) Stay the same
(d) None of these

54. When the temperature of a gas is increased in a balloon, the volume of the balloon will:
(a) Increase*
(b) Decrease
(c) Stay the same
(d) None of these

55. When the volume of a gas is decreased, the pressure of the gas will:
(a) Increase*
(b) Decrease
(c) Stay the same
(d) None of these

56. A balloon is filled with helium gas to a pressure of 107 kPa when the temperature is 295 K. If the temperature changes to 318 K, what will be the pressure of the helium in the balloon?
(a) 115 kPa*
(b) 125 kPa
(c) 135 kPa
(d) 145 kPa

57. An isothermal process is governed by:
(a) Boyle's law*
(b) Charles's law
(c) Joule's law
(d) Gay Lussac's law

58. When the expansion follows the law $PV^n = C$, the process is:
(a) Isothermal process
(b) Adiabatic process
(c) Polytropic process*
(d) Hyperbolic process

59. Real gas follows the relation:
(a) $PV = RT$
(b) $PV^n = RT$
(c) $PV = nRT$*
d) $(PV)^n = C$

60. For real gas, $C_p = C_v$, at:
(a) Absolute zero*
(b) Critical temperature
(c) Triple point
(d) All temperature

61. Choose the correct option
(a) Specific volume of water decreases on freezing
(b) Boiling point of water decreases with increasing pressure
(c) Specific volume of CO2 increases on freezing
(d) Freezing temperature of water decreases with increasing pressure*

62. Choose the correct option
(a) The slope of vapourisation curve is always negative*
(b) The slope of vapourisation curve is always positive
(c) The slope of sublimation curve in negative for all pure substances
(d) The slope of fusion curve is positive for all pure substances.

63. Choose the correct option
(a) The process of passing from liquid to vapour is condensation
(b) An isothermal line is also a constant pressure line during wet region*
(c) Pressure and temperature are independent during phase change
(d) The term dryness fraction is used to describe the fraction by mass of liquid in the mixture of liquid water and water vapour.

64. The latent heat of vapourisation at critical point is
(a) less than zero
(b) greater than zero
(c) equal to zero*
(d) none of the above.

65. Select correct option
(a) Critical point involves equilibrium of solid and vapour phases
(b) Critical point involves equilibrium of solid and liquid phases
(c) Critical point involves equilibrium of solid, liquid and vapour phases
(d) Triple point involves equilibrium of solid, liquid and vapour phases*

66. With the increase in pressure
(a) boiling point of water increases and enthalpy of evaporation increases
(b) boiling point of water increases and enthalpy of evaporation decreases*
(c) boiling point of water decreases and enthalpy of evaporation increases.

67. With increase in pressure
(a) enthalpy of dry saturated steam increases
(b) enthalpy of dry saturated steam decreases*
(c) enthalpy of dry saturated steam remains same
(d) enthalpy of dry saturated steam first increases and then decreases.

68. Dryness fraction of steam is defined as
(a) mass of water vapour in suspension/(mass of water vapour in suspension + mass of dry steam)
(b) mass of dry steam/mass of water vapour in suspension
(c) mass of dry steam/(mass of dry steam + mass of water vapour in suspension) *
(d) mass of water vapour in suspension/mass of dry steam.

69. The specific volume of water when heated at 0°C
(a) first increases and then decreases (b) first decreases and then increases*
(c) increases steadily
(d) decreases steadily.

70. Only throttling calorimeter is used for measuring
(a) very low dryness fraction upto 0.7
(b) very high dryness fraction upto 0.98*
(c) dryness fraction of only low pressure steam
(d) dryness fraction of only high pressure steam.

71. Heat of superheated steam is given by
(a) $h_{\text{sup}} = h_f + h_{fg} + c_{ps} \log_e \frac{T_{\text{sup}}}{T_s}$ *
(b) $h_{\text{sup}} = h_f + xf_g$
(c) $h_{\text{sup}} = h_f + h_{fg}$
(d) $h_{\text{sup}} = h_f + xh_{fg} + c_{ps} \log_e \frac{T_{\text{sup}}}{273}$

72. Volume of wet steam (per kg) with dryness fraction x is given by
(a) $x^3 v_g$
(b) xv_f

(c) $x^2(v_g - v_f)$
(d) none of the above*

73. Internal latent heat is given by
(a) $h_{fg} - \frac{pv_g}{J}$ *
(b) $h_g - \frac{pv_g}{J}$
(c) $h_{\text{sup}} - \frac{pv_f}{J}$
(d) $h_{fg} + \frac{pv_g}{J}$

74. Entropy of 1 kg of water at T K is given by
(a) $c_{pw} \log_e \frac{T}{273}$ *
(b) $c_{pw} \log_e \frac{T_2}{T_1}$
(c) $c_{pw} \log_{10} \frac{T}{273}$
(d) $c_{pw} \log_e \frac{T_2}{273}$

75. Entropy of wet steam (1 kg) is given by
(a) $s_f + \frac{xh_{fg}}{T_s}$ *
(b) $s_g + \frac{xh_{fg}}{T_s}$
(c) $s_f + \frac{h_{fg}}{T_s}$
(d) $s_f + c_{ps} \log_e \frac{T_{\text{sup}}}{T_s}$

76. In throttling process
(a) $h_1^2 = h_2$
(b) $h_1 = h_2$ *
(c) $h_1 = h_2 + \frac{h_{fg}}{T_s}$
(d) $h_2 = h_1 + \frac{h_{fg}}{T_s}$

77. In isentropic process
(a) $W = 2(u_2 - u_1)$
(b) $W = (u_2 - u_1)^2$
(c) $W = u_2 - u_1$ *
(d) $W = (u_2 - u_1)^{1/2}$

78. If all the variables of a stream are independent of time it is said to be in
(a) steady flow*
(b) unsteady flow
(c) uniform flow
(d) closed flow

79. A control volume refers to
(a) a fixed region in space*
(b) a specified mass
(c) an isolated system
(d) a reversible process only

80. Internal energy of a perfect gas depends on
(a) temperature, specific heats and pressure
(b) temperature, specific heats and enthalpy
(c) temperature, specific heats and entropy
(d) temperature only*

81. In reversible polytropic process
(a) true heat transfer occurs*
(b) the entropy remains constant
(c) the enthalpy remains constant
(d) the internal energy remains constant

82. An isentropic process is always
(a) irreversible and adiabatic
(b) reversible and isothermal
(c) frictionless and irreversible
(d) reversible and adiabatic*

83. The net work done per kg of gas in a polytropic process is equal to
(a) $p_1 v_1 \log_e \frac{v_2}{v_1}$
(b) $p_1(v_1 - v_2)$

(c) $p_2\left(v_2-\frac{v_1}{v_2}\right)$

(d) $\frac{p_1v_1-p_2v_2}{n-1}$ *

84. Steady flow occurs when
(a) conditions do not change with time at any point*
(b) conditions are the same at adjacent points at any instant
(c) conditions change steadily with the time
(d) $(\partial v/\partial t)$ is constant

85. A reversible process requires that
(a) there be no heat transfer
(b) Newton's law of viscosity be satisfied
(c) temperature of system and surroundings be equal
(d) there be no viscous or Coulomb friction in the system*

86. The first law of thermodynamics for steady flow
(a) accounts for all energy entering and leaving a control volume*
(b) is an energy balance for a specified mass of fluid
(c) is an expression of the conservation of linear momentum
(d) is primarily concerned with heat transfer

87. The characteristic equation of gases pV = mRT holds good for
(a) monoatomic gases
(b) diatomic gas
(c) real gases*
(d) ideal gases

88. A gas which obeys kinetic theory perfectly is known as
(a) monoatomic gas
(b) diatomic gas
(c) real gas
(d) perfect gas*

89. Work done in a free expansion process is
(a) zero*
(b) minimum
(c) maximum
(d) positive

90. Which of the following is not a property of the system ?
(a) Temperature
(b) Pressure
(c) Specific volume
(d) Heat*

91. In the polytropic process equation pv^n = constant, if n = 0, the process is termed as
(a) constant volume
(b) constant pressure*
(c) constant temperature
(d) adiabatic

92. In the polytropic process equation pv^n = constant, if n is infinitely large, the process is termed as
(a) constant volume*
(b) constant pressure
(c) constant temperature
(d) adiabatic

93. The processes or systems that do not involve heat are called
(a) isothermal processes
(b) equilibrium processes
(c) thermal processes
(d) adiabatic processes*

94. In a reversible adiabatic process the ratio (T_1/T_2) is equal to

(a) $\left(\frac{p_1}{p_2}\right)^{\frac{\gamma-1}{\gamma}}$ *

(b) $\left(\frac{v_1}{v_2}\right)^{\frac{\gamma-1}{\gamma}}$

(c) $\left(v_1v_2\right)^{\frac{\gamma-1}{\gamma}}$

(d) $\left(\frac{v_2}{v_1}\right)^{\gamma}$

95. In isothermal process
(a) temperature increases gradually (b) volume remains constant

(c) pressure remains constant
(d) change in internal energy is zero*

96. During throttling process
(a) internal energy does not change (b) pressure does not change
(c) entropy does not change
(d) enthalpy does not change*

97. When a gas is to be stored, the type of compression that would be ideal is
(a) isothermal*
(b) adiabatic
(c) polytropic
(d) constant volume

98. If a process can be stopped at any stage and reversed so that the system and surroundings are exactly restored to their initial states, it is known as
(a) adiabatic process
(b) isothermal process
(c) ideal process*
(d) frictionless process

99. The state of a substance whose evaporation from its liquid state is complete, is known as
(a) vapour
(b) perfect gas*
(c) air
(d) steam

100. In SI units, the value of the universal gas constant is
(a) 0.8314 J/mole/K
(b) 8.314 J/mole/K
(c) 83.14 J/mole/K
(d) 8314 J/mole/K*

101. When the gas is heated at constant pressure, the heat supplied
(a) increases the internal energy of the gas
(b) increases the temperature of the gas
(c) does some external work during expansion
(d) both(b) and(c) *

102. The gas constant (R) is equal to the
(a) sum of two specific heats
(b) difference of two specific heats*
(c) product of two specific heats
(d) ratio of two specific heats.

103. The heat absorbed or rejected during a polytropic process is
(a) $\left(\frac{\gamma-n}{\gamma-1}\right) x\ work\ done$ *
(b) $\left(\frac{\gamma-n}{\gamma-1}\right)^2 x\ work\ done$
(c) $\left(\frac{\gamma-n}{\gamma-1}\right)^{1/2} x\ work\ done$
(d) $\left(\frac{\gamma-n}{\gamma-1}\right)^3 x\ work\ done$

104. Second law of thermodynamics defines
(a) heat
(b) work
(c) enthalpy
(d) entropy*

105. For a reversible adiabatic process, the change in entropy is
(a) zero*
(b) minimum
(c) maximum
(d) infinite

106. For any reversible process, the change in entropy of the system and surroundings is
(a) zero*
(b) unity
(c) negative
(d) positive

107. For any irreversible process the net entropy change is
(a) zero
(b) positive*
(c) negative
(d) infinite

108. The processes of a Carnot cycle are
(a) two adiabatic and two constant volume
(b) one constant volume and one constant pressure and two isentropic
(c) two adiabatic and two isothermals

(d) two isothermals and two isentropic*

109. Isentropic flow is
(a) irreversible adiabatic flow
(b) ideal fluid flow
(c) perfect gas flow
(d) reversible adiabatic flow*

110. In a Carnot engine, when the working substance gives heat to the sink
(a) the temperature of the sink increases
(b) the temperature of the sink remains the same*
(c) the temperature of the source decreases
(d) the temperatures of both the sink and the source decrease

111. If the temperature of the source is increased, the efficiency of the Carnot engine
(a) decreases
(b) increases*
(c) does not change
(d) will be equal to the efficiency of a practical engine

112. The efficiency of an ideal Carnot engine depends on
(a) working substance
(b) on the temperature of the source only
(c) on the temperature of the sink only
(d) on the temperatures of both the source and the sink*

113. The efficiency of a Carnot engine using an ideal gas as the working substance is
(a) $\frac{T_1 - T_2}{T_1}$ *
(b) $\frac{T_1}{T_1 - T_2}$
(c) $\frac{T_1 T_2}{T_1 - T_2}$
(d) $\frac{T_1 - T_2}{T_1 T_2}$

114. In a reversible cycle, the entropy of the system
(a) increases
(b) decreases
(c) does not change*
(d) first increases and then decreases

115. A frictionless heat engine can be 100% efficient only if its exhaust temperature is
(a) equal to its input temperature
(b) less than its input temperature
(c) 0°C
(d) 0°K*

116. Kelvin-Planck's law deals with
(a) conservation of energy
(b) conservation of heat
(c) conservation of mass
(d) conversion of heat into work*

117. Which of the following statements is correct according to Clausius statement of second law of thermodynamics ?
(a) It is impossible to transfer heat from a body at a lower temperature to a body at a higher temperature
(b) It is impossible to transfer heat from a body at a lower temperature to a body at a higher temperature, without the aid of an external source*
(c) It is possible to transfer heat from a body at a lower temperature to a body at a higher temperature by using refrigeration cycle
(d) None of the above.

118. According to Kelvin-Planck's statement of second law of thermodynamics
(a) It is impossible to construct an engine working on a cyclic process, whose sole purpose is to convert heat energy into work
(b) It is possible to construct an engine working on a cyclic process, whose sole purpose is to convert the heat energy into work
(c) It is impossible to construct a device which while working in a cyclic process produces no effect other than the transfer of heat from a colder body to a hotter body
(d) None of the above*

119. The property of a working substance which increases or decreases as the heat is supplied or removed in a reversible manner is known as
(a) enthalpy
(b) internal energy
(c) entropy*
(d) external energy.

120. The entropy may be expressed as a function of
(a) pressure and temperature*
(b) temperature and volume
(c) heat and work
(d) all of the above

121. The change of entropy, when heat is absorbed by the gas is
(a) positive*
(b) negative
(c) positive or negative.

122. Which of the following statements is correct ?
(a) The increase in entropy is obtained from a given quantity of heat at a low temperature
(b) The change in entropy may be regarded as a measure of the rate of the availability of heat for transformation into work
(c) The entropy represents the maximum amount of work obtainable per degree drop in temperature
(d) All of the above*

123. The condition for the reversibility of a cycle is
(a) the pressure and temperature of working substance must not differ, appreciably from those of the surroundings at any stage in the process
(b) all the processes taking place in the cycle of operation, must be extremely slow
(c) the working parts of the engine must be friction free
(d) all of the above*

124. In an irreversible process there is a
(a) loss of heat*
(b) no loss of work
(c) gain of heat
(d) no gain of heat.

125. The main cause for the irreversibility is
(a) mechanical and fluid friction
(b) unrestricted expansion
(c) heat transfer with a finite temperature difference
(d) all of the above*

126. The efficiency of the Carnot cycle may be increased by
(a) increasing the highest temperature
(b) decreasing the highest temperature
(c) increasing the lowest temperature
(d) decreasing the lowest temperature*

127. Which of the following is the correct statement ?
(a) All the reversible engines have the same efficiency*
(b) All the reversible and irreversible engines have the same efficiency
(c) Irreversible engines have maximum efficiency
(d) All engines are designed as reversible in order to obtain maximum efficiency.

128. Choose correct option
(a) A perfect gas does not obey the law pv = RT
(b) A perfect gas obeys the law pv = RT and has constant specific heat*
(c) A perfect gas obeys the law pv = RT but have variable specific heat capacities.

129. Boyle's law states that, when temperature is constant, the volume of a given mass of a perfect gas
(a) varies directly as the absolute pressure
(b) varies inversely as the absolute pressure*
(c) varies as square of the absolute pressure
(d) does not vary with the absolute pressure.

130. Charles's law states that if any gas is heated at constant pressure, its volume
(a) changes directly as it absolute temperature*
(b) changes inversely as its absolute temperature

(c) changes as square of the absolute temperature
(d) does not change with absolute temperature.

131. The equation of the state per kg of a perfect gas is given by
(a) $p^2v = RT$
(b) $pv = RT$*
(c) $p^2 = RT$
(d) $p^2v^2 = RT$
where p, v, R and T are the pressure, volume, characteristic gas constant and temperature of the gas
respectively.

132. The equation of state of an ideal gas is a relationship between the variables :
(a) pressure and volume
(b) pressure and temperature
(c) pressure, volume and temperature*
(d) none of the above.

133. Joule's law states that the specific internal energy of a gas depends only on
(a) the pressure of the gas
(b) the volume of the gas
(c) the temperature of the gas*
(d) none of the above.

134. The mechanical equivalent of heat 'J' is equal to
(a) 4.1864 kg/kcal
(b) 41.8 kg/kcal
(c) 4.1868 kcal/kg
(d) 4.1868 kJ* (SSC JE 2018)

135. In a closed system
(a) energy transfers from surrounding to system
(b) energy transfers from system to surrounding
(c) energy transfers from system to surrounding and vice-versa*
(d) energy as well as mass cross the boundaries (SSC JE 2018)

136. The first and second laws of thermodynamics help to derive the following properties, respectively
(a) Pressure and temperature
(b) temperature and entropy*
(c) pressure and entropy
(d) temperature and enthalpy (SSC JE 2018)

137. What is the main characteristic of a quasi–static process?
(a) An infinitely slow process*
(b) A random process
(c) A spontaneous process
(d) A stationary process (SSC JE 2018)

138. In metric system the unit of heat is given as
(a) CHU
(b) BTU
(c) kcal*
(d) Kelvin (SSC JE 2018)

139. Which one of the following relationships defines the Helmholtz function F?
(a) F = H + TS
(b) F = H − TS
(c) F = U – TS*
(d) F = U + TV (SSC JE 2018)

140. The ratio of two specific heats of air is equal
(a) 0. 17
(b) 0. 24
(c) 0.1
(d) 1.41* (SSC JE-2007)

141. Following relationship defines the Gibb's free energy G
(a) G = H + TS
(b) G = H – TS*
(c) G = U + TS
(d) F = U – TS (SSC JE 2017)

142. Triple point ___.
(a) Occurs in a mixture of two or more gases
(b) Is the point, where three phases exists together*
(c) Occurs in sublimation
(d) None of these (SSC JE 2017)

143. A system consisting of more than one phase is called ____.
(a) Isolated system
(b) Open system

(c) Non-uniform system
(d) Heterogeneous system* (SSC JE 2017)

144. When water at atmospheric pressure is heated from 30 to 75 degree Centigrade, then the heat absorbed is known as _____.
(a) Specific heat
(b) Sensible heat*
(c) Latent heat
(d) Normal heat (SSC JE 2017)

145. Gibbs free energy is considered at which one of the following condition?
(a) Isothermal, isochoric
(b) Isobaric, isochoric
(c) Isothermal, isobaric*
(d) None of these (SSC JE 2017)

146. The amount of heat required to raise the temperature of 1 kg of water from 00C to the saturation temperature Ts0C at a given constant pressure is defined as:
(a) Superheat
(b) Entropy
(c) Latent heat
(d) Sensible heat* (SSC JE 2017)

147. Properties of substances like pressure, temperature and density, in thermodynamic co-ordinates are ___.
(a) path functions
(b) point functions*
(c) cyclic functions
(d) real functions (SSC JE 2017)

148. Stirling and Ericsson cycles are–
(a) reversible cycles*
(b) irreversible
(c) quasi static cycles
(d) semi-reversible cycles
(SSC JE 2007, 2017)

149. Which of the following, 'path function' quantity is
(a) Work done*
(b) pressure
(c) Enthalpy
(d) Temperature (SSC JE 2012)

150. The time constant of a thermocouple is:
(a) the time taken to attain the final temperature to be measured
(b) the time taken to attain 50% of the value of initial temperature difference
(c) the time taken to attain 63.2% of the value of initial temperature differences*
(d) determined by the time taken to reach 100^0C from 0^0C (SSC JE 2017)

151. The boiling and freezing points for water are marked on a temperature scale P as 130^0 P and -20^0P respectively. What will be the reading on this scale corresponding to 60^0C on Celsius scale?
(a) 60^0 P
(b) 70^0 P*
(c) 90^0 P
(d) 110^0 P (SSC JE 2014)
Hint: : $\theta_1 = \theta_2$

$$\frac{100-t}{100-0} = \frac{130P-P}{130-(-20P)}$$

152. Zeroth law of thermodynamics states that
(a) two thermodynamic system are always in thermal equilibrium with each other
(b) if two systems are in thermal equilibrium, then the third system will also be in thermal equilibrium
(c) two system not in thermal equilibrium with a third system will also not in thermal equilibrium with each other
(d) when two systems are in thermal equilibrium with a third system, they are in thermal equilibrium with each other*
(SSC JE 2018)

153. Two gases X and Y having the same temperature T, the same pressure P and the same volume V are mixed. If the mixture has the volume V and temperature T, then the pressure of the mixutre will be:
(a) P
(b) 2P*
(c) 4P
(d) P/2 (SSC JE 2014)

154. Molar volume is equal to
(a) 22.41 m^3 at NTP*
(b) 2.41 m^3 at NTP

(c) 29.27 m^3 at NTP
(d) 1.03 m^3 at NTP (SSC JE 2018)

155. Molal specific heats of an ideal gas depend on
(a) its pressure
(b) its temperature
(c) both its pressure and temperature
(d) number of atoms in a molecule
(SSC JE 2018)

156. Charle's law states
(a) $p_1V_1 = p_2V_2$
(b) $p_1/T_1 = p_2 / T_2$
(c) $p_1/V_1 = p_2 / V_2$
(d) $V_1/T_1 = V_2 /T_2$* (SSC JE 2018)

157. SpecificVolume of a gas is the volume of
(a) gas at NTP
(b) Unit mass of that gas*
(c) total amount of gas at some stated temperature and pressure
(d) gas at -273^0C (SSC JE 2018)

158. For any gas
(a) $C_p = C_v$
(b) $C_p < C_v$
(c) $C_p > C_v$*
(d) None of these (SSC JE 2018)

159. The degree of disorder when two gases are mixed is
(a) Less than that of individual gases
(b) higher than that of individual gases*
(c) unpredictable compared to individual gases
(d) same as that of the individual gases
(SSC JE 2018)

160. For a gas with n degree of freedom, what will be the value of C_p/C_v?
(a) n + 1
(b) n – 1
(c) 1 – 2/n
(d) 1 + 2/n* (SSC JE 2018)

161. Which gas can attain be highest efficiency for the same compression rise?
(a) Any of the gases
(b) Diatomic gases
(c) Mono atomic gases*
(d) Tri–atomic gases (SSC JE 2018)

162. Gases have
(a) two specific heats*
(b) three specific heats
(c) one specific heat
(d) None of these (SSC JE 2018)

163. Two gases A and B with their molecular weights 28 and 44 respectively, expand at constant pressures through the same temperature range. The ratio of quantity of work done by the two gases (A:B) is ____.
(a) 7:11
(b) 11:7*
(c) 4:11
(d) 7:4 (SSC JE 2017)
Hint: : $M \propto 1/M$

164. The pressure P of an ideal gas and its mean kinetic energy E per unit volume are related as
(a) P = E/2
(b) P = E
(c) P = 3E/2
(d) P = 2E/3* (SSC JE 2017)
Hint: : E = (3/2)RT and PV = RT

165. According to Dalton's law, the total pressure of the mixture of gases is equal to –
___
(a) greater of the partial pressures of all
(b) average of the partial pressures of all
(c) sum of the partial pressure of all*
(d) sum of the partial pressures of all divided by average molecular weight (SSC JE 2017)

166. Superheated vapour behaves:
(a) exactly as gas
(b) as steam
(c) as ordinary
(d) approximately as gas* (SSC JE 2017)

167. According to Boyle's law for a perfect gas:
(a) $T_2/T_1 = P_2/P_1$, if V is kept constant
(b) $T_2/T_1 = V_2/V_1$, if P is kept constant
(c) $P_1/P_2 = V_2/V_1$, if T is kept constant*
(d) None of these (SSC JE 2017)

168. According to which law, all perfect gases change in volume by $(1/273)_{th}$ of their original volume at 0^0C for every 1^0C change in temperature when pressure remains constant:
(a) Joule's law
(b) Boyle's law
(c) Regnault's law
(d) Charle's law* (SSC JE 2017, 2007)

169. A perfect gas at 270C was heated until its volume was doubled. The temperature of the gas will now be:
(a) 270^0C
(b) 540^0C
(c) 327^0C*
(d) 729^0C (SSC JE 2017)
Hint: : From Charle's law, $V \propto T$.

170. The difference between two specific heats, C_p and C_v for a gas represents _____.
(a) Increase in kinetic energy of gas molecules
(b) Increase in potential energy of gas molecules
(c) External work done*
(d) Increase in volume (SSC JE 2017)
Hint: : $C_p - C_v = R$
and $pV = RT$

171. The universal gas constant of a gas is the product of molecular weight of the gas and ____.
(a) Gas constant*
(b) Specific heat at constant pressure
(c) Specific heat at constant volume
(d) None of these (SSC JE 2017)

172. A football was inflated to a gauge pressure of 1 bar when the ambient temperature was 15^0C. When the game started next day, the air temeperature at the stadium was 5^0C. Assume that the volume of the football remains constant at 2500 cm^3. Gauge pressure of air to which the ball must have been originally inflated so that it would equal 1 bar gauge at the stadium is ——:
(a) 2.23 bar
(b) 1.94 bar
(c) 1.07 bar*
(d) 1 bar (SSC JE 2017)
Hint: : $P_2 = P_{G2} + P_{atm}$
$P_2 = 100 + 101.325$
$P_2 = 201.325$ KPa
$T_1 = 15^0C = 288K$
$T_2 = 5^0C = 278K$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

173. Under ideal conditions, isothermal, isobaric, isochoric and adiabatic processes are ___.
(a) static processes
(b) dynamic processes
(c) quasi-static processes*
(d) stable processes (SSC JE 2017)

174. Compressed air coming out from a punctured football.
(a) becomes hotter
(b) becomes cooler*
(c) remains at the same temperature
(d) may become hotter or cooler depending upon the humidity of the surrounding air (SSC JE 2017)
Hint: : The compressed air coming out of a punctured tyre becomes cooler is due to the principle of Joule-Thompson Effect.
The air inside the tube of a vehicle is under high pressure. When a puncture occurs to the tyre, air inside comes out from that high pressure to outside environment which is at low pressure. In this process, it has to travel through a small hole. To do this, the air needs energy. This energy is obtained from the internal heat of the air. So it uses its internal energy to come out. Thus by expensing its internal heat, it comes out of the tube and since it has lost its heat, it becomes cool.

175. According to kinetic theroy of gases, at absolute zero ———
(a) Specific heat of molecules reduces to zero
(b) Kinetic energy of molecules reduces to zero*
(c) Volume of gas reduce to zero
(d) Pressure of gas reduce to zero (SSC JE 2017)

176. Equal volume of all gases, at the same temperature and pressure, contain equal number of molecules. This is according to – ___
(a) Charle's law
(b) Avagardo's law*
(c) Joule's law
(d) Gay Lussac (SSC JE 2017)

177. Specific heat of a gas, CP = CV, at:
(a) Absolute zero*
(b) Critical temperature
(c) Triple point
(d) All temperatures (SSC JE 2017)

178. For an ideal gas the compressibility factor is:
(a) unity*
(b) infinity
(c) some finite value greater than unity
(d) zero (SSC JE 2014)

179. Which gas among the following has the highest value of adiabatic index?
(a) Oxygen
(b) Methane
(c) Helium*
(d) Nitrogen (SSC JE 2014)
Hint: :
$CO_2 \rightarrow 1.29$
Air $\rightarrow 1.40$
He $\rightarrow 1.66$
$CH_4 \rightarrow 1.31$
$H_2 \rightarrow 1.40$
$NH_3 \rightarrow 1.29$

180. For a particular ideal gas, the value of R is 0.280 kJ/kgK and the value of γ is 1.375. The value of C_p and C_v are, respectively, in kJ/ kg
(a) 1.111, 0.66
(b) 1.2, 0.70
(c) 1.25, 0.8
(d) 1.0267, 0.7467* (SSC JE 2014)
Hint: : $C_p = \frac{\gamma R}{\gamma - 1}$
$C_V = \frac{R}{\gamma - 1}$

181. Neglecting changes in potential and kinetic energies, the shaft work during a steady flow process is given by
(a) $\int pdv$
(b) $-\int vdp$*
(c) $\int Tds$
(d) $\int sdT$ (SSC JE 2013)

182. During an adiabatic process, the pressure P of a fixed mass of an ideal gas changes by ΔP and its volume V changes by ΔV. The value of ΔV/V is given by
(a) $\frac{1}{\gamma^3}.\frac{\Delta P}{P}$
(b) $\frac{-1}{\gamma}.\frac{\Delta P}{P}$*
(c) $\frac{\Delta P}{P}$
(d) $-\gamma.\frac{\Delta P}{P}$ (SSC JE 2012)
Hint: : $K_a = \gamma P = -\frac{\Delta P}{\Delta V / V}$

183. In case of Boyle's law, if pressure increases by 1%, the percentage decrease in volume is
(a) 100/101%*
(b) 1/100%
(c) 0%
(d) 1/101% (SSC JE 2012)
Hint: :
$P_1V_1 = P_2V_2$
$PV = \frac{101}{100}PV_2 \Rightarrow V_2 = \frac{100V}{101}$
$\frac{V_1 - V_2}{V_1} = \frac{V_1 - (100V_1/101)}{V_1} x100$
$\Delta V = 100/101\%$

184. Which of the following gases has the highest value of characteristic gas constant (R)?
(a) Carbon Dioxide
(b) Sulphur Dioxide
(c) Oxygen
(d) Nitrogen* (SSC JE 2012)

Hint: : Nitrogen: 296.80 [J/ kg K]
Carbon dioxide: 188.92 [J/ kg K]
Sulphur dioxide: 129.78 [J/ kg K]
Oxygen: 259.84 [J/ kg K]

185. Internal energy change of an ideal gas is function of the following-
(a) Pressure
(b) Temperature*
(c) Volume
(d) Humidity (SSC JE, 2012)

186. What is the resultant of sum of product of pressure and volume (PV) with internal energy U known as?
(a) Enthalpy*
(b) Entopy
(c) Specific heat
(d) Work-done (SSC JE 2018)

187. Work is considered to be a superior from of energy as compared to heat energy because ——
(a) work is direct energy
(b) work is useful from of energy
(c) While work can be fully converted into heat, heat cannot be fully converted into work*
(d) It is often required to convert heat into work and not vice versa (SSC JE 2017)

188. General energy equation for system boiler is given by
(a) $Q = H_1 + H_1$
(b) $Q = H_2 + H_1$
(c) $Q = H_2 - H_1$*
(d) $Q = H_2 - H_1 + KE$ (SSC JE 2018)

189. Maximum work by an expansion of a gas in a closed system is possible when process takes place at constant:
(a) pressure*
(b) temperature
(c) volume
(d) enthalpy (SSC JE 2017)

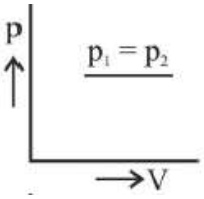
190. The heat absorbed or rejected during a polytrophic process is equal to
(a) $\left(\frac{\gamma-n}{\gamma-1}\right)^{1/2} x\,work$
(b) $\left(\frac{\gamma-n}{n-1}\right)^{1/2} x\,work$
(c) $\left(\frac{\gamma-n}{\gamma-1}\right) x\,work$ *
(d) $\left(\frac{\gamma-n}{\gamma-1}\right)^{2} x\,work$

191. General energy equation for a steady flow system is
(a) $H_1 + \frac{V_1^2}{2gJ} + \frac{Z_1}{J} + Q = \frac{V_2^2}{2gJ} + losses$
(b) $H_1 + \frac{V_1^2}{2gJ} + \frac{Z_1}{J} + Q = \frac{V_2^2}{2gJ} + work + losses$
(c) $H_1 + \frac{V_1^2}{2gJ} + \frac{Z_1}{J} + Q = H_2 + \frac{V_2^2}{2gJ} + \frac{Z_2}{J} + work + losses$ *
(d) $H_1 + \frac{V_1^2}{2gJ} + \frac{Z_1}{J} = H_2 - \frac{V_2^2}{2gJ} + \frac{Z_2}{J} + work + losses$

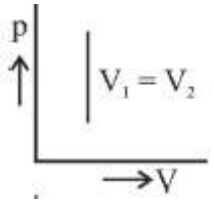
192. Which of the following statements hold TRUE for the first law of thermodynamics?
(a) The entropy of the system remains
(b) The total energy of the system remains constant
(c) The total internal energy of the system remains constant*
(d) Work done by the system is equal to the heat transferred by the system
(SSC JE 2018)

193. In a throttling process, which on of the following parameters remains constant?
(a) Temperature
(b) Pressure
(c) Enthalpy*
(d) Entropy (SSC JE 2018)

194. The polytrophic process on p–V diagram is represented by the figure
(a)



(b)



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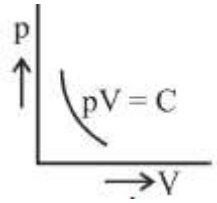
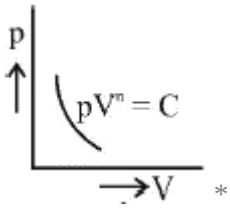


(d)



*

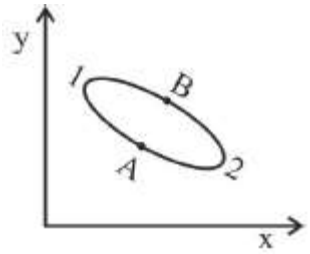
(SSC JE 2018)

195. Which of the following processes is irreversible process
(a) Isothermal
(b) Adiabatic
(c) Throttling*
(d) All options are correct (SSC JE 2018)

196. Enthalpy is an —— of a system and its unit is ——
(a) extensive property, kJ*
(b) extensive property, kJ/kg
(c) intensive property, kJ
(d) intensive property, kJ (SSC JE 2018)

197. The heat interaction of the system is a function of temperature only Q = 30 + 1t kJ. If the system does a work of 2 kJ/K. What is the increase in Internal energy per degree temperature
(a) –1*
(b) 0
(c) 1
(d) Can not be determined (SSC JE 2018)
Hint: : Q = 30 + 1t
dQ/dt = 1.kJ /K
dw = 2 kJ/K
dQ = dw + du
du = dQ – dw
du = 1 – 2
du = –1 kJ/K

198. Which equation is the CORRECT representation of the process shown below?



(a) $Q_{A1-2} + W_{A1-2} = Q_{B2-1} + W_{B2-1}$
(b) $Q_{A1-2} - W_{A1-2} = Q_{B2-1} - W_{B2-1}$
(c) $Q_{A1-2} + W_{B2-1} = Q_{A1-2} + W_{B2-1}$*
(d) $Q_{B2-1} - W_{A1-2} = Q_{B2-1} - W_{A1-2}$
(SSC JE 2018)

199. For a process which is non-flow, the first law of thermodynamics states_____.
(a) dU = Q – W*
(b) dU = Q + W
(c) dH = Q − W
(d) dH = Q + W (SSC JE 2018)

200. What happens when the heat supplied to the system is more than the work transfer out of the system?
(a) Constant internal energy
(b) Decrease in internal energy
(c) Increase in internal energy*
(d) Internal energy cannot be determined
(SSC JE 2018)

201. Constant volume process is
(a) isopiestic process
(b) hyperbolic process
(c) isometric process*
(d) polytrophic process (SSC JE 2018)

202. Which formula is the CORRECT depiction of slope of adiabatic curve?
(a) $\frac{dP}{dV} = -\gamma\frac{P}{V}$ *
(b) $\frac{dP}{dV} = \frac{P}{V}$
(c) $\frac{dP}{dV} = -\frac{P}{V}$

(d) $\frac{dP}{dV} = \gamma \frac{P}{V}$ (SSC JE 2018)

203. What is the drop in enthalpy (in kJ/kg) for a steam whistle which is perfectly insulated and does not work has an exit velocity of steam at 40 m/sec
(a) 0.8*
(b) 8
(c) 80
(d) 800 (SSC JE 2018)
Hint: :

$$H_1 + \frac{1}{2}V_1^2 + Z_1 g + Q = H_2 + \frac{1}{2}V_2^2 + Z_2 g + W$$

Q = 0 kJ/kg; W = 0 kJ/kg; $Z_1 = Z_2 = 0$
$V_1 = 0$

204. A gas is compressed frictionless from an initial state of y m^3 and 1 MPa to a final state of 0.2 m^3 and 1 MPa. There is a transfer of 40 kJ of heat from the gas and a drop of 20 kJ in internal energy. What is the initial state volume of the gas.
(a) 0.2
(b) 0.22*
(c) 19.8
(d) 20.2 (SSC JE 2018)
Hint: : $\partial Q = dU + \partial W$
$-40 = -20 + \partial W$
$\partial W = -20$
$\partial W = PdV$

$$W = \int_1^2 PdV$$

$$-20x10^3 = P\int_1^2 dV$$

$$= 1x10^6(V_1 - V_2)$$

= y – 0.2

205. Which of the following is the other name of isentropic process?
(a) a reversible isothermal process
(b) a reversible adiabatic process*
(c) a reversible isobaric process
(d) a reversible isochoric process
(SSC JE 2018)

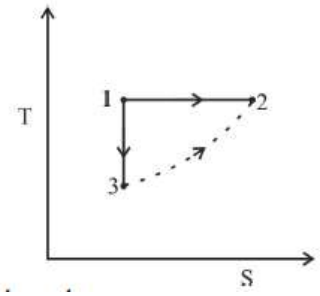
206. Which equation best describes the first law of thermodynamics?
(a) $\partial q = \partial u + \partial w$*
(b) $\partial q = \partial u - \partial w$
(c) $\partial q = \partial w - \partial u$
(d) $\partial u = \partial q + \partial w$ (SSC JE 2018)

207. The heat transfer Q, the work done W and the change in internal energy U are all zero in the case of
(a) a rigid vessel containing steam at 150^0C left in the atmosphere which is at 25^0C
(b) 1 kg of gas contained in an insulated cylinder expanding as the piston moves slowly outwards
(c) a rigid vessel containing ammonia gas connected through a valve to an evacuated rigid vessel, the vessel, the valve and the connecting pipes being well insulated and the valve being opened and after a time, condition through the two vessels becoming uniform*
(d) 1 kg of air flowing adiabatically from the atmosphere a previously evacuated bottle.
(SSC JE 2018)

208. The internal energy of the system is a function of temperature only U= 30 + 0.5t kJ. If the system does the work of 0.5 kJ/K, What is the increase interaction per degree temperature?
(a) -1
(b) 0
(c) 1*
(d) cannot be determined (SSC JE 2018)
Hint: :
According to first law of thermodynamics:
$\delta Q = \Delta U + \delta W$
Unit of each term is kJ.
U(t) =30+0.5t kJ
dU = 0.5 kJ/K
$\delta Q = \Delta U + \delta W = 0.5 + 0.5 = 1$ kJ/K

209. The work done by a system is 45 kJ. If the internal energy of the system is decreased by 15 kJ. What is the heat received (in kJ) by the system
(a) –60
(b) –30
(c) 30*
(d) 60 (SSC JE 2018)
Hint: : $\delta Q = \Delta U + \delta W = (-15) + (+45) = 30$ kJ

210. A reversible adiabatic in a T-S diagram is a__.



(a) point
(b) vertical line*
(c) horizontal line
(d) parabolic curve (SSC JE 2018)

211. Which equation clearly defines the entropy change during the isothermal process for a system with m kg of gas at pressure P_1, volume V_1, temperature T_1 and entropy S_1 is heated to state points of pressure P_2, volume V_2, temperature T_2 and entropy S_2?

(a) $mC_v \ln\frac{T_2}{T_1}$

(b) $mC_p \ln\frac{T_2}{T_1}$

(c) $mR\ln\frac{V_2}{V_1}$ *

(d) $mC_v\left(\frac{n-\gamma}{n-1}\right)\ln\frac{T_2}{T_1}$ (SSC JE 2018)

212. Adiabatic process is
(a) essentially as isentropic process
(b) non-heat transfer process*
(c) reversible process
(d) constant temperature process
(SSC JE 2018)

213. What is the temperature at which a system goes under a reversible isothermal process without heat transfer?
(a) Absolute zero temperature*
(b) Critical temperature
(c) Reversible temperature
(d) Boiling temperature (SSC JE 2018)

214. Which equation defines the enthalpy (h) of a system?

(a) $U+\frac{PV}{J}$ *

(b) $U-\frac{PV}{J}$

(c) $U+\frac{R}{JPV}$

(d) $U + JPV$ (SSC JE 2018)

215. Which one of the following phenomena occurs when gas in a piston-in-cylinder assembly expands reversibly at constant pressure?
(a) Heat is added to the gas*
(b) Heat is removed from the gas
(c) Gas does work from its own stored energy
(d) Gas undergoes adiabatic expansion
(SSC JE 2018)

216. Total heat supplied at constant volume is
(a) $Q = m \times Cp \times (T_2 - T_1)$
(b) $Q = m \times R \times (T_2 - T_1)$
(c) $Q = mCv\ (T_2 + T_1)$
(d) $Q = mCv \times (T_2 - T_1)$* (SSC JE 2018)

217. The ratio of the specific heat at constant pressure to specific heat at constant volume for air is equal to
(a) 1.4*
(b) 0.14
(c) 14
(d) 140 (SSC JE 2018)

218. Air at 1 bar and 40°C flows into an evacuated tank until the pressure in the tank is 1 bar. Assume that the process is adiabatic and the temperature of the surroundings is 40°C. What is the final temperature of air (in °C)?
(a) 160
(b) 165*
(c) 170
(d) 175 (SSC JE 2018)

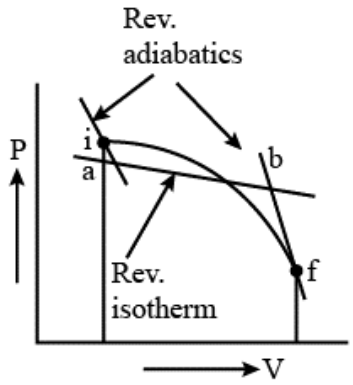
Hint: : $T_f = \frac{C_p}{C_v}T_i = \gamma T_i$

$T_i = 273 + 40 = 313$ K

219. In a cyclic process, the heat transfers are +20 kJ, -5 kJ, -10 kJ and +15kJ . What is the net work (in k.J) for the cyclic process?
(a) +5
(b) –10
(c) +20*
(d) –20 (SSC JE 2018)
Hint: : Net work done in the cycle = Net heat in the cycle
W_{net} = +20 kJ - 5 kJ - 10 kJ + 15 kJ = +20 kJ

220. A liquid of mass 1.5 kg with specific heat of 3 kJ/kg-K is stirred causing the temperature rise of 10°C. What is the work done (in kJ) for the process, if the system is insulated?
(a) –45*
(b) 0
(c) 45
(d) 60 (SSC JE 2018)
Hint: : From first law of thermodynamic
$\partial Q = dU + \partial W$
though system is isulated
$\partial Q = 0$
$\partial W = - dU$
$= m\, c\, \Delta T$
$= - 1.5 \times 3 \times 10$
$= - 45$

221. Which is the CORRECT expression for heattransferred from the given P-V diagram, if the area under i-a-b-f is equal to area under i-f?



(a) $Q_{if} > Q_{ab}$
(b) $Q_{if} < Q_{ab}$
(c) $Q_{if} = Q_{ab}$*
(d) None of these (SSC JE 2018)

Hint: :
Using Clausius' Theorem.
Process i-f
$Q_{i-f} = U_f - Ui + W_{if}$ .....(i)
Process i-a-b-f
$Q_{iabf} = U_f - U_i + W_{iabf}$ .....(ii)
since
$W_{if} = W_{iabf}$
$\therefore$ from Eqn. (i) and (ii)
$Q_{if} = Q_{iabf}$
$= Q_{ia} + Q_{ab} + Q_{bf}$
since $Q_{ia} = 0$ and $Q_{bf} = 0$
$Q_{if} = Q_{ab}$
Heat transferred in the process i-f is equal to the heat transferred in the isothermal process a-b.

222. Which of the following is TRUE for real thermodynamic cycle?

(a) $0 < \oint \frac{dQ}{T} < x$

(b) $\oint \frac{dQ}{T} < 0$ *

(c) $\oint \frac{dQ}{T} = 0$

(d) $\oint \frac{dQ}{T} = x$ (SSC JE 2018)

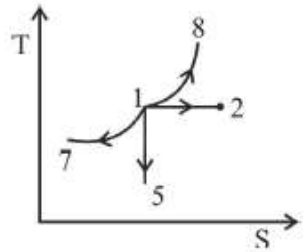
Hint: :

$\oint \frac{dQ}{T} < 0$ for irreversible

$\oint \frac{dQ}{T} = 0$ for reversible.

$\oint \frac{dQ}{T} = 0$ for impossible.

223. Which of the following is true for the process 1–5 on temperature plot?



(a) pv^{γ} = constant*
(b) pv = constant
(c) p = constant

(d) v = constant (SSC JE 2018)

224. The ideal efficiency of an Ericsson cycle with perfect regeneration and operating between two given temperature limits is:
(a) equal to Joule cycle
(b) equal to Carnot cycle*
(c) equal to Brayton cycle
(d) less than Carnot cycle (SSC JE 2017)

225. Calculate the enthalpy of 3 kg of fluid that occupies a volume of $1.5m^3$, if the internal energy is 3.5 M Joules/kg and the pressure is 0.3 MN/m^2:
(a) 3.95 MJ
(b) 3.65 MJ
(c) 10.95 MJ*
(d) None of these (SSC JE 2017)
Hint: : m = 3 kg, u = 3.5MJ/kg, P = 0.3 MN/m
$U = m \times u = 3 \times 3.5 = 10.5$ MJ
$V = 1.5\ m^3$
$H = U + PV$,
$H = 10.5 + 0.3 \times 1.5 = 10.95$ MJ

226. It is proposed to make a direct heat–to–work converter out of an elementary system which absorbs heat while doing isothermal work exactly equal to the heat absorbed, thereby keeping internal energy constant. Such a system is:
(a) not possible*
(b) possible
(c) not desirable
(d) commendable (SSC JE 2017)

227. During a process on the closed system its internal energy increases by twice the units than the heat added to it. It is possible due to:
(a) radiation of heat from surroundings
(b) lowering of the temperature
(c) increasing of the temperature
(d) performing of shaft work on the system* (SSC JE 2017)

228. Which of the following represents the perpetual motion of the first kind:
(a) engine with 100% thermal efficiency
(b) a full reversible engine
(c) transfer of heat energy from low temperature source to high temperature source
(d) a machine that continuously creates its own energy* (SSC JE 2017)

229. A perpetual motion machine of the first kind i.e. a machine which produces power without consuming any energy is ____.
(a) Possible according to first law of thermodynamics
(b) Impossible according to first law of thermodynamics*
(c) Impossible according to second law of thermodynamics
(d) Possible according to second law of Thermodynamics (SSC JE 2017)

230. A perpetual motion machine is .
(a) a thermodynamic machine
(b) a non-thermodynamic machine
(c) a hypothetical machine whose operation would violate the laws of thermodynamics*
(d) None of these (SSC JE 2017)

231. According to Kelvin–Plank's statement, a perpetual motion machine of ——
(a) Firsk kind is possible
(b) Firsk kind is impossible
(c) Second kind is impossible*
(d) Second kind is possible (SSC JE 2017)

232. First law of thermodynamics furnishes the relationship between :
(a) heat and work
(b) heat work and properties of the system*
(c) various properties of the system
(d) various thermodynamic processes (SSC JE 2009)

233. A closed balloon containing 10 kg of helium receives 5 kJ/kg of heat. During this process, the volume of the balloon slowly increases by $0.2\ m^3$ at constant pressure of 100 kpa. The change in internal energy, in KJ, is
(a) 10
(b) 20
(c) 30*
(d) 70 (SSC JE 2014)
Hint: : Work, $dw = P \times dv$

= 100 KPa × 0.2 m^3
δW = 20 kJ
From first law of thermodynamics
δQ = du + δW
50 = du + 20
du = 30 kJ

234. The expression $\int_1^2 pdv$ gives the measure of work done during of work done during
(a) steady flow reversible process
(b) Non-flow reversible process*
(c) Open system and any process
(d) any system and any process
(SSC JE 2013)

235. If two liquids at different temperatures are mixed, then the final temperature of the mixture of liquids can be obtained by using
(a) Zeroth law of thermodynamics
(b) First law of thermodynamics*
(c) Second law of thermodynamics
(d) Third law of thermodynamics
(SSC JE 2013)

236. Enthalpy is calculated as the-
(a) sum of internal energy and the product of pressure and density of the system
(b) sum of internal energy and the product of pressure and volume of the system*
(c) difference between the internal energy and the product of pressure and volume of the system
(d) difference between the internal energy and the product of pressure and density of the system (SSC JE 2015)

237. A heat engine receives 1000 kJ of heat and produces 600 kJ of work. The amount of heat rejected in kJ and the efficiency percentage of the engine, respectively will be
(a) 600, 40%
(b) 400, 60%
(c) 400, 40%
(d) 600, 60% (SSC JE 2015)
Hint: : $\eta_{HE} = (W/Q_A)x100$
= (600/1000) x 100
= 60%
$W = Q_A - Q_R$
$600 = 1000 - Q_R$

238. The efficiency of carnot Engine depends
(a) the capacity of the engine
(b) the duration of working of the engine
(c) the nature of the working fluid
(d) the temperature limits of the working fluid* (SSC JE 2007, 2015)

239. A heat engine is supplied with 278 kW of heat at a constant fixed temperature of 283^0C and the heat rejection takes place at 5^0C the engine is reversible if the heat rejected, in kW, is
(a) 139*
(b) 208
(c) 35
(d) 70 (SSC JE 2013)
Hint: : $\frac{Q_R}{Q_A} = \frac{T_L}{T_H}$

240. If the efficiency of a Carnot engine is 40% then the COP of the Carnot refrigerator will be_____
(a) 1
(b) 1.5*
(c) 2.5
(d) 3 (SSC JE 2018)
Hint: : $\eta_c = \frac{T_1 - T_2}{T_1}$
$(COP)_P = \frac{T_1}{T_1 - T_2}$
$(COP)_P - (COP)_R = 1$

241. Two heat engines operating between temperatures 2000 K and T K and 500 k respectively. What is the intermediate temperature, if the efficiency of both the cycles is same?
(a) 900 K
(b) 1000 K*
(c) 1500 K
(d) 1600 K (SSC JE 29.01.2018)

242. A Carnot heat engine is working with an efficiency of 50%. If the cycle is converted into a heat pump after reversing,

then what is the coefficient of performance of the heat pump?
(a) 1
(b) 1.67
(c) 2*
(d) 2.5 (SSC JE 2018)

243. Which law governs the process of heat transfer?
(a) Zeroth law of thermodynamics
(b) First law of thermodynamics
(c) Second law of thermodynamics*
(d) Third law of thermodynamics
(SSC JE 2018)

244. A Carnot heat pump is used to maintain a room at a temperature of ToC, the initial temperature of the room was –10°C. If the power requirement of the pump is 20 kW and the heat provided is 150 kW. What will be the value of T?
(a) 0
(b) 30*
(c) 303
(d) Cannot be determined
(SSC JE 2018)
Hint: : $\eta = W / Q_A$

$(COP)_P = 1/\eta$

$\frac{T_H}{T_H - T_L} = (COP)_P$

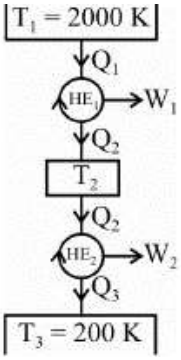
T values in K.

245. What happens to the COP of a heat pump, when the temperature difference between source and sink is increased?
(a) Decreases*
(b) First decreases then increases
(c) First increases then decreases
(d) Increases (SSC JE 2018)

246. A heat engine performs a work of 100 kJ per cycle. The efficiency of the encgine is 50%. What will be the amount of heat rejected (in kJ) per cycle?
(a) 0
(b) 50
(c) 100*
(d) 200 (SSC JE 2018)
Hint: : $\eta = W / Q_A$

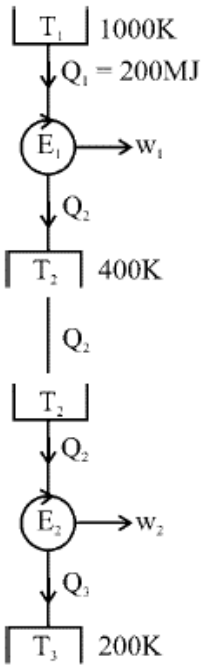
$\frac{Q_1 - Q_2}{Q_1} = \eta$

247. Two Carnot engine are connected in a series with working extreme temperatures as 2000 K and 200 K respectively. What is the efficiency of the first Carnot engine (in %)
(a) 0
(b) 50
(c) 68*
(d) 90 (SSC JE 2018)
Hint: : $T_2 = \sqrt{T_1 T_2}$



and $\eta = 1 - \frac{T_2}{T_1}$

248. A Carnot engine operates between temperature 1000 K and 400 K. the heat rejected by the first Carnot engine is used by the second Carnot engine, whose sink temperature is 200 K. If the net heat absorbed by the first Carnot engine is 200 MJ. What is the heat rejected (in MJ) by the second Carnot engine
(a) 40*
(b) 50
(c) 60
(d) 70 (SSC JE 2018)
Hint: :



$$\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{400}{1000} = 0.60$$

$Q_2 = Q_1 - w_1$
$Q_2 = Q_1 - 0.60\ Q_1$
$Q_2 = 0.40\ Q_1 = 80$ MJ

$$\eta_{E2} = 1 - \frac{T_2}{T_1} = 1 - \frac{200}{400} = 0.50$$

$Q_3 = Q_2 - w_2$
$Q_3 = Q_2 - 0.50\ Q_2 = 80 - 40$
$Q_3 = 40$ MJ

249. If a Carnot engine rejects 1/4 of the heat from the reservoir, what is the efficiency of Carnot engine?
(a) 0.25
(b) 0.5
(c) 0.75*
(d) 0.8 (SSC JE 2018)

250. Efficiency of a Carnot engine is 75%. If the cycle direction is reversed, COP of the reversed Carnot cycle is
(a) 1.33*
(b) 0.75
(c) 0.33
(d) 1.75 (SSC JE 2018)

251. 2500 kJ/min heat is supplied to heat engine at 727^0C. It rejects heat at 900 kJ/min at 223^0C. This type of engine is
(a) Ideal
(b) Irreversible
(c) impossible*
(d) practical (SSC JE 2018)
Hint: :

$$\eta_{carnot} = \eta_{\max} = 1 - \frac{T_L}{T_H} = 1 - \frac{496}{1000} = 50.4\%$$

$$\eta_{engine} = 1 - \frac{Q_L}{Q_H} = 1 - \frac{900}{2500} = 64\%$$

Engine efficiency can not be greater than Carnot efficiency, so cycle is impossible.

252. What process does Carnot cycle consist of?
(a) Two isothermal and two adiabatic process*
(b) Two isothermal and two constant volume process
(c) Two isothermal and two constant pressure process
(d) Two constant pressure and two constant volume process/oes melele oyeeJe Deewj oes melele (SSC JE 2018)

253. Which of the below stated are properties of a PMM-2?

(1) When network is equal to the heat absorbed and work efficiency is 100%
(2) Heat is exchanged from one heat reservoir only
(3) It violates Kelvin–Planck statement
(4) It is a hypothetical machine

(a) (1), (2) and (4)
(b) (1) (3) and (4)
(c) (2) (3) and (4)
(d) (1) (2) (3) and (4)* (SSC JE 2018)

254. If a Carnot refrigerator has a COP of 6. What is the ratio of the lower to the higher absolute temperature?
(a) 1–6
(b) 7–8
(c) 6–7*
(d) 1–7 (SSC JE 2018)

Hint: : $(COP)_R = \frac{T_L}{T_H - T_L}$

255. Clausius' statement and Kelvin-Planck's statement are____
(a) not connected
(b) two parallel statements of the second*
(c) violation of one does not violates the other
(d) false statements (SSC JE 2018)

256. A heat engine working between the source at 200^0C and rejects heat at 25^0C receives 5 kW of heat. Work done for this engine is equal to 0 kW. Does this satisfy the inequality of Clausius?
(a) Yes*
(b) No
(c) Cannot be determined
(d) None of these (SSC JE 2018)
Hint: : Clausius Inequality:

$\oint dQ/T \leq 0$

The equality holds good for a reversible cycle and the inequality holds good for an irreversible cycle.

$(Q_h/T_h - Q_c/T_c) = 5/473 - 5/298$
$= -0.0062 \leq 0$
Thus the engine satisfies the inequality of Clausius.

257. A carnot heat pump works between temperature limits of 277^0C and 27^0C. Its COP is
(a) 1.108
(b) 1.2
(c) 2.2*
(d) 9.26 (SSC JE 2018)

258. A carnot engine rejects 30% of absorbed heat at a sink at 30^0C. The temperature of the heat source is
(a) 100^0C
(b) 433^0C
(c) 737^0C*
(d) 1010^0C (SSC JE 2018)

259. If a heat engine produces work without the consumption of energy, then what kind of machine is this?
(a) Perpetual motion machine of first kind (PMM1*
(b) Perpetual motion machine of second kind (PMM2
(c) Perpetual motion machine of third kind (PMM3
(d) None of these (SSC JE 2018)

260. An inventor states that the new engine he invented rejects 30% of the heat it absorbs from the reservoir, while the temperature of the source and the sink are maintained at 500K and 200K respectively. His engine is equivalent to ———
(a) Carnot engine
(b) Joule engine
(c) Impossible engine*
(d) Stirling engine (SSC JE 2018)

261. If a Carnot cycle operates between temperature 1800 K and 1000 K. What will be the lowest heat rejection per kW net output of the engine?
(a) 0.8
(b) 1
(c) 1.25*
(d) 2 (SSC JE 2018)

262. Which of the following statement is TRUE about an engine having an efficiency of 60% working under a temperature of 1000 K and 540 K?
(a) It is a Diesel engine
(b) It is an Carnot engine
(c) It is an Otto engine
(d) It is a Hypothetical engine*
(SSC JE 2018)
Hint: : Efficiency comes out 46% which is not possible. Engine efficiency is always less than 46%.

263. If the ratio of the lower to the higher absolute temperature is 5/6. What is the efficiency of the Carnot engine?
(a) 1/6*
(b) 2/6
(c) 3/6
(d) 5/6 (SSC JE 2018)

264. Ericsson cycle consists of the following four processes :
(a) two isothermals and two isentropics
(b) two isothermals and two constant volumes
(c) two isothermals and two constant pressures*
(d) two adiabatics and two constant
(SSC JE 2017)

265. The more effective way of increasing efficiency of Carnot engine is to ___.
(a) increase higher temperature
(b) decrease higher temperature
(c) increase lower temperature
(d) decrease lower temperature*
(SSC JE 2017)

266. An engine working between positive temperatures _____.
(a) Can be a heat pump
(b) cannot be a heat pump
(c) must be a heat pump*
(d) can be a heat pump if frictionless machine is used (SSC JE 2017)

267. Which equation best represents the entropy (s) of a system with two parts with entropy x and y respectively
(a) s = x + y*
(b) s = x – y
(c) s < x + y
(d) s > x + y (SSC JE 2018)

268. One kg of air (R = 287 J/kg-K) goes through an irreversible process between two equilibrium state 1 (30^0C, 1.2 m^3) and state 2 (30^0C, 0.8m^3). What is the change in entropy (in J/kg-K)?
(a) –116.36*
(b) –50.53
(c) 50.53
(d) 116.36 (SSC JE 2018)

Hint: : $\Delta S = R\ln\left(\frac{V_2}{V_1}\right)$

269. Which equation best represents the net entropy change(s) for an irreversible process?
(a) s = 0
(b) s = 1
(c) s < 0
(d) s > 0* (SSC JE 2018)

270. Water flows through a turbine in which due to friction there is a temperature from 35^0C to 37^0C. If there is no heat transfer taking place during the process. What is the change in the entropy of water?
(a) 0.0271*
(b) 0.079
(c) 0.406
(d) 0.496 (SSC JE 2018)

Hint: : $\Delta S = mC_v \ln\left(\frac{T_2}{T_1}\right)$

271. The entropy always increases for an isolated system and when the equilibrium is reached, it is
(a) maximum*
(b) same as the initial starting state
(c) more than initial starting state
(d) zero (SSC JE 2018)

272. When the degree of randomness increases, what is the change in entropy?
(a) Decreases
(b) Increases*
(c) Unpredictable
(d) Remains constant (SSC JE 2018)

273. Entropy change depends on ——
(a) heat transfer*
(b) mass transfer
(c) change of temperature
(d) thermodynamic state
(SSC JE 2017, 2018)

274. For a thermodynamic process to be reversible, the temperature difference between hot body and working substance should be _____.
(a) Zero*
(b) minimum
(c) maximum
(d) infinity (SSC JE 2017)

275. When a process undergoes a complete cycle then the change of entropy will be:
(a) +ve value

(b) –ve value
(c) zero value*
(d) +ve or –ve value depending on initial condition (SSC JE 2017)

276. The property of a working substance, which increases or decreases accourding to the heat supplied or removed in a reversible manner, is called ____.
(a) Enthalpy
(b) Entropy*
(c) Reversibility
(d) None of these (SSC JE 2017)

277. When two gases suddenly mix up with each other then resultant entropy of the system will:
(a) decrease
(b) increase*
(c) remain same
(d) may increase or decrease depending upon the initial conditions of the gases (SSC JE 2017)

278. The value of entropy at 0°C is taken as
(a) 1
(b) 0*
(c) −1
(d) 0.5 (SSC JE 2017)

279. When a liquid boils at constant pressure, the following parameter increases:
(a) temperature
(b) heat of vaporization
(c) kinetic energy
(d) entropy* (SSC JE 2017)

280. Entropy is a measure of ——
(a) Reversible heat transfer
(b) System efficiency
(c) Degree of randomness*
(d) System temperature (SSC JE 2017)

281. The latent heat of evaporation of water at 100 K is 2560 kJ/kg. What is the change of entropy associated with the evaporation?
(a) 25×10^3 kJ/kg-K
(b) 6.86 kJ/kg-K
(c) – 25.6 kJ/kg-K
(d) 25.6 kJ/kg-K (SSC JE 2014)

Hint: : $S = \frac{\Delta Q}{T}$

282. For the same temperature of source and sink, the thermal efficiency of Carnot cycle:
(a) is less than that of Stirling cycle.
(b) is greater than that of Stirling cycle.
(c) may be greater or less than that of Stirling cycle depending upon the working substance.
(d) is equal to thermal efficiency of Stirling cycle* (DMRC 2018)

283. Entropy:
(a) is a point function*
(b) in a reversible adiabatic process always increases
(c) is a path function
(d) has the unit of kJ/kg (DMRC 2018)

284. Carnot cycle consists of:
(a) Two reversible constant volume and two reversible isentropic process.
(b) Tw o reversible isobaric and two reversible isentropic process.
(c) Two reversible isothermal and two reversible isobaric process.
(d) Two reversible isothermal and two reversible isentropic process* (DMRC 2018)

285. One of the Tds equation has the form:
(a) Tds = dh + pdv
(b) Tds = dh + vdp
(c) Tds = dh – vdp*
(d) Tds = du – pdv (DMRC 2018)

286. The zeroth law of thermodynamics defines
_____.
(a) temperature*
(b) pressure
(c) internal energy
(d) enthalpy (DMRC 2018)

287. The relationship between the coefficient of performance of refrigerator ($[COP]_R$) and coefficient of performance of heat pump ($[COP]_{HP}$) is given as:
(a) $[COP]_R = 2[COP]_{HP}$
(b) $[COP]_{HP} = [COP]_R$

(c) $[COP]_R = [COP]_{HP} - 1$*
(d) $[COP]_R = [COP]_{HP} + 1$ (DMRC 2018)

288. A tank containing air is stirred by a paddle wheel. The work input to the paddle wheel is 9000 kJ and heat transferred to the surroundings from the tank is 3000 kJ. The external work done by the system is:
(a) Zero*
(b) 3000 kJ
(c) 6000 kJ
(d) None of these (DMRC 2016)

289. If the thermal efficiency of a Carnot heat engine is 40%, then Co-efficient of performance of a refrigerator working within same temperature limits would be:
(a) 4.5
(b) 3.5
(c) 1.5*
(d) None of these (DMRC 2016)

290. 72. A heat engine is supplied with 280 kJ/s of heat at a constant fixed temperature of 520 K and heat rejection takes place at 260 K temperature. If the engine is reversible, the heat rejected would be approximately equal to:
(a) 85 kJ/s
(b) 110 kJ/s
(c) 140 kJ/s*
(d) None of these (DMRC 2016)