# APPENDIX C

## Multiple-Choice Questions

### Choose the correct answer

1. A certain quantity of fluid in a cylinder bounded by a moving piston constitutes a
   (a) closed system (b) open system
   (c) steady flow system (d) isolated system
2. A collection of matter bounded by a wall impervious to the flow of mass and energy is called
   (a) a closed system (b) an open system
   (c) an isolated system (d) none of these
3. Which of the following is not an extensive property?
   (a) Volume (b) Pressure
   (c) Energy (d) Entropy
4. Tarr is a unit of
   (a) Temperature (b) Pressure
   (c) Volume (d) Energy
5. Which of the following is not a point function?
   (a) Temperature (b) Pressure
   (c) Energy (d) Power
6. The unit of power in S.I. units is
   (a) pascal (b) edges
   (c) watts (d) joule
7. The unit of energy is
   (a) watt (b) calorie
   (c) joule/s (d) watt-s
8. The unit of temperature in S.I. units is
   (a) Centigrade (b) Celsius
   (c) Kelvin (d) Fahrenheit
9. Which of the following is not the unit of pressure?
   (a) pascal (b) bar
   (c) newton (d) atmosphere
10. Which of the following is the basic of temperature measurement?
    (a) Zeroth law of thermodynamics
    (b) First law of thermodynamics
    (c) Second law of thermodynamics
    (d) Third law of thermodynamics
11. The Kelvin temperature of a system can be measured by a
    (a) mercury-in-glass thermometer
    (b) thermocouple

(c) constant volume gas thermometer
(d) resistance thermometer

**12.** The standard fixed point of thermometry is the
(a) ice point
(b) triple point of water
(c) normal boiling point of water
(d) sulphur point

**13.** Which of the following may be used for measuring high temperatures beyond 1063°C?
(a) Electrical resistance thermometer
(b) Platinum-platinum/10% Rhodium thermo couple
(c) Constant pressure gas thermometer
(d) Optical method using Planck's law of thermal radiation

**14.** Thermodynamic properties are macroscopic coordinates significant only for systems existing in states of
(a) thermal equilibrium
(b) mechanical equilibrium
(c) chemical equilibrium
(d) thermodynamic equilibrium

**15.** Which of the following is the characteristic feature of a quasi-static process?
(a) Infinite slowness
(b) Rapidity
(c) Stability
(d) Stationary existence

**16.** In highly rarefied gases, the concept of which of the following loses validity?
(a) Thermodynamic equilibrium
(b) Continuum
(c) Stability
(d) Macroscopic view point

**17.** The unit of velocity in S.I. units is
(a) m/sec
(b) m/s
(c) cm/s
(d) ft/sec

**18.** Which of the following is a succession of equilibrium states?
(a) Isenthalpic process
(b) Isentropic process
(c) Quasi-static process
(d) Isothermal process

**19.** A mixture of air and liquid air is
(a) a pure substance
(b) not a pure substance
(c) homogeneous and invariable in chemical composition throughout its mass
(d) one having relative proportions of oxygen and nitrogen constant in gas and liquid phases

**20.** When the mean free path of the molecules of a gas approaches the order of magnitude of the dimensions of the vessel, the concept of which of the following loses validity?
(a) Continuum
(b) Stability
(c) Equilibrium
(d) Entropy

**21.** Most of the real processes are
(a) quasi-static
(b) non-quasi-static
(c) adiabatic
(d) isothermal

**22.** The two-property rule holds that the state of a pure substance of given mass can be fixed by specifying

(a) any two properties
(b) two extensive properties
(c) any two intensive properties
(d) two independent intensive properties

**23.** A series of state changes of a system such that the final state is identical with initial state constitutes a
(a) quasi-static process
(b) thermodynamic cycle
(c) reversible process
(d) non-quasi-static process

**24.** A diaphragm-type pressure transducer measures a pressure of 1mm Hg, which is equal to
(a) 1.336 bar
(b) 13.3 Pa
(c) 133 Pa
(d) 13.3 kPa

**25.** The displacement work done by a system is given by $\int pdv$. It is valid for
(a) any process
(b) a quasi-static process
(c) a non-quasi-static process
(d) an isentropic process

**26.** When a current flows through a resistor, taken as a system, across a potential difference, the energy flowing into the system is
(a) work transfer
(b) heat transfer
(c) work and heat transfer
(d) electricity

**27.** Work done in free expansion is
(a) positive
(b) negative
(c) zero
(d) maximum

**28.** The integrating factor of the quasi-static displacement work is
(a) $\frac{1}{T}$
(b) $\frac{1}{P}$
(c) $\frac{1}{V}$
(d) $\frac{P}{V}$

**29.** The cyclic integral of which of the following is zero?
(a) Work transfer
(b) Heat transfer
(c) Temperature
(d) Latent heat

**30.** The integrating factor of reversible heat transfer is
(a) $\frac{1}{T}$
(b) $\frac{1}{P}$
(c) $\frac{1}{V}$
(d) $\frac{P}{T}$

**31.** Which of the following is not a boundary phenomenon?
(a) Work transfer
(b) Heat transfer
(c) Mass transfer
(d) Change of temperature

**32.** If the value of $n$ is infinitely large in polytrophic process $pV^n$ = constant, then the process is known as
(a) constant volume
(b) constant pressure
(c) constant temperature
(d) constant enthalpy

**33.** The expression $\int pdv$ can be used for obtaining work of a
(a) non flow reversible process
(b) steady flow reversible process
(c) adiabatic irreversible process
(d) throttling process

**34.** The difference of the amount of work done on a system and the amount of heat supplied from the system to bring the system back to its initial state is
(a) greater than zero (b) less than zero
(c) zero (d) maximum

**35.** The work done by a closed system will increase when the value of the polytrophic index $n$
(a) increases
(b) decreases
(c) first increases and then decreases
(d) first decreases and then increases

**36.** Internal energy is defined by the
(a) zeroth law of thermodynamics (b) first law of thermodynamics
(c) second law of thermodynamics (d) law of entropy

**37.** Heat transferred to a closed stationary system at constant volume is equal to
(a) work transfer (b) increase in internal energy
(c) increases in enthalpy (d) increase in Gibbs function

**38.** Which of the following does not change during a throttling process?
(a) Enthalpy (b) Entropy
(c) Volume (d) Pressure

**39.** For an inviscid incompressible fluid flowing through a duct, the steady flow energy equation reduces to
(a) Euler equation (b) Bernoulli equation
(c) Stoke equation (d) Novier–Stoke equation

**40.** Reversible steady flow work interaction is equal to
(a) $\int pdv$ (b) $-\int vdp$
(c) $u_1 - u_2$ (d) $p_1v_1 - p_2v_2$

**41.** Reversible work transfer in a closed system is equal to
(a) $\int_1^2 pdv$ (b) $-\int_1^2 vdp$
(c) $h_1 - h_2$ (d) $p_1v_1 - p_2v_2$

**42.** Heat transferred to a system at constant pressure is equal to
(a) work transfer (b) change is internal
(c) change is enthalpy (d) change is entropy

**43.** The mass and energy of which of the following always remain constant?
(a) Closed system (b) Non-isolated system
(c) Open system (d) Universe

**44.** A perpetual motion machine of the first kind is one
(a) which perpetually moves without any cessation
(b) fictitious machine which violates the first law of thermodynamics
(c) in which there is complete absence of friction
(d) which violates Kelvin–Planck statement

**45.** For an inviscid frictionless fluid flowing through a pipe
$Vdp + \bar{V}d\bar{V} + gdz = 0$
This is called
(a) Euler equation
(b) Bernoulli equation
(c) Steady flow energy equation
(d) Stokes' equation

**46.** An evacuated bottle is fitted with a valve through which air form the atmosphere at 760 mm Hg, 25°C is allowed to flow slowly to fill the bottle. If no heat is transferred to or from the air in the bottle, what will be its temperature when the pressure in the bottle reaches 760 mm Hg?
(a) 25°C
(b) 50°C
(c) 80°C
(d) 144.2°C

**47.** A gas is flowing through an adiabatic nozzle. If the inlet velocity of gas is negligible and there is an enthalpy drop of 45 kJ/kg, the velocity of gas exiting the nozzle is
(a) 100 m/s
(b) 200 m/s
(c) 300 m/s
(d) 350 m/s

**48.** Perpetual motion machine of the Second kind violates the
(a) first law of thermodynamics
(b) Kelvin–Planck statement
(c) Clausius statement
(d) third law of thermodynamics

**49.** The continual motion of a movable device in complete absence of friction
(a) violates the first law of thermodynamics
(b) violates the second law of thermodynamics
(c) is the perpetual motion of the third kind
(d) is the perpetual motion of the second kind

**50.** The efficiency of a reversible cycle depends upon the
(a) nature of the working substance
(b) amount of the working substance
(c) temperatures of the two reservoirs between which the cycle operates
(d) type of cycle followed

**51.** The efficiency of a thermodynamic cycle cannot be infinite since it
(a) violates the first law of thermodynamics
(b) violates the second law of thermodynamics
(c) violates the third law of thermodynamics
(d) rejects no heat

**52.** If the thermal of Carnot engine is 1/5, the COP of the corresponding Carnot refrigerator is

(a) 5 (b) 4
(c) 6 (d) 3

**53.** A Carnot cycle operates between two temperatures $T_1$ and $T_2$ ($T_1 > T_2$). If $T_1$ is increased by $\Delta T$ and $T_2$ is decreased by $\Delta T$, the efficiency $\eta_2$ in the second case and the efficiency $\eta_1$ in the first case are related by
(a) $\eta_1 > \eta_2$ (b) $\eta_2 > \eta_1$
(c) $\eta_1 = \eta_2$ (d) Unpredictable

**54.** If the time taken by a system to execute a process through a finite gradient is infinitely large, the process
(a) becomes reversible (b) remains irreversible
(c) becomes isothermal (d) is adiabatic

**55.** Two insulated tanks containing ideal gases at different pressures and temperatures are connected to each other and gases are allowed to mix. The process that occurs is called
(a) free expansion (b) constant enthalpy
(c) constant internal energy (d) reversible adiabatic

**56.** A thermodynamic cycle is impossible if
(a) $\oint \frac{dQ}{T} < 0$ (b) $\oint \frac{dQ}{T} = 0$
(c) $\oint \frac{dQ}{T} > 0$ (d) $\oint ds > 0$

**57.** The more effective way of increasing the efficiency of a Carnot engine is to
(a) increase the higher temperature
(b) decrease the lower temperature
(c) decrease the higher temperature
(d) increase the lower temperature

**58.** The efficiency of Carnot engine operating between the source temperature of 200°C and the sink temperature of 30°C is equal to
(a) 85% (b) 80%
(c) 36% (d) 12%

**59.** The door of a running refrigerator inside a room is left open. Which of the following statements is correct?
(a) The room will be cooled to the temperature inside the refrigerator.
(b) The room will be cooled only slightly.
(c) The room will be gradually warmed up.
(d) The temperature of the room will remain unaffected.

**60.** An insulated container is divided into two compartments *A* and *B* by a thin diaphragm. While *A* contains a mass of gass at pressure '*p*' and temperature '*T*', *B* is evacuated. The diaphragm is punctured and the gas in *A* rushes into *B*. The process is called
(a) adiabatic (b) isentropic
(c) constant internal energy (d) free expansion

**61.** Which of the following is not an agent of internal irreversibility?
(a) Friction
(b) Turbulence

(c) Electrical resistance
(d) Heat interaction at the boundary

**62.** **Assertion (A):** Dissipation of electrical work into internal energy or heat is irreversible. **Reasoning (R):** The conversion of heat into electrical work of the same magnitude is not possible.
Select the answer using the code given below:
(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, and R is not the correct explanation of A.
(c) Both A and R are false.
(d) A is true, but R is false.

**63.** All spontaneous processes are
(a) reversible
(b) irreversible
(c) impossible
(d) prone to second law violation

**64.** An engine operates between temperature limits of 900 K and $T_2$, and another engine operates between $T_2$ and 400 K. For both the engines to be equally efficient, $T_2$ will be equal to
(a) 600 K
(b) 650 K
(c) 625 K
(d) 700 K

**65.** **Assertion (A):** On a $p$-$v$ plane, we cannot draw two reversible adiabatic lines from the same point.
**Reasoning (R):** It is impossible to construct a perpetual motion machine of the second kind.
Select the answer using the code given below:
(a) Both A and R is true, but R is not the correct explanation of A.
(b) Both A and R is true, and R is the correct explanation A.
(c) Both A and R is false.
(d) A is true, but R is false.

**66.** The relation $du = Tds - pdv$ or $Tds = dh - vdp$ is true for true for
(a) reversible processes only
(b) reversible adiabatic processes only
(c) all processes
(d) a reversible cycle only

**67.** When a system is in equilibrium, any conceivable change in entropy would be
(a) maximum
(b) zero
(c) positive
(d) negative

**68.** An isentropic process
(a) is always reversible
(b) is always adiabatic
(c) need not be adiabatic or reversible
(d) is always frictionless

**69.** In comparison with slopes of constant pressure lines for an ideal gas on $T$-$s$ plot, the slops of constant volume lines are
(a) less
(b) more
(c) equal
(d) unpre dictable

**70.** The entropy of a system
(a) can never decrease
(b) can never increase
(c) may increase or decrease
(d) will always remain constant

**71.** Which of the following is not a conserved quantity?
(a) mass
(b) energy
(c) momentum
(d) exergy

**72.** The exergy of an isolated system in a process
(a) can never increase
(b) can never decrease
(c) always remains constant
(d) is always positive

**73.** The entropy of an isolated system in a process
(a) can never increase
(b) can never decrease
(c) always remains constant
(d) is always negative

**74.** Match List 1 with List 2 and choose the correct answer from the code given below.

| List 1 (Laws of thermodynamics) | List 2 (Introduces/Defiles) |
|---|---|
| (A) First | (1) Absolute Zero temperature |
| (B) Second | (2) Internal energy |
| (C) Zeroth | (3) Temperature |
| (D) Third | (4) Entropy |

Code

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

**75.** **Assertion (A):** Through one point, there can pass only one reversible adiabatic.
**Reasoning (R):** Two constant property lines cannot intersect each other.
Choose the correct answer from the code given below:
(a) Both A and R are true, but R is not he proper explanation for A.
(b) Both A and R are true and R is the proper explanation for A.
(c) Both A and R are false.
(d) A is false, but R is true.

**76.** In the expansion process of steam through a turbine if the entropy decrease due to heat loss from the turbine exceeds the entropy increase of steam due to friction, then the entropy change of steam for the process would be
(a) positive
(b) negative
(c) zero
(d) may be positive or negative

**77.** The entropy of an isolated system always increases and when equilibrium condition is reached, it is
(a) maximum
(b) zero
(c) more
(d) minimum

**78.** The extent of irreversibility of an process undergone by a system in the given surroundings is determined by estimating the

(a) entropy change of the system
(b) entropy change of the surroundings
(c) entropy increase of the universe
(d) entropy decrease of the universe

**79.** Two identical finite bodies of constant heat capacity at temperatures $T_1$ and $T_2$ are available for work in a heat engine. The final temperature $T_f$ reached by the bodies on delivery of maximum work is

(a) $T_f = \frac{T_1 + T_2}{2}$ (b) $T_f = \sqrt{T_1 T_2}$

(c) $T_f = T_1 - T_2$ (d) $T_f = \sqrt{T_1^2 T_2}$

**80.** A body of mass 2 kg and $c_p$ = 1.00 kJ/kgK is available at 600 K. If the atmosphere is at 300 K and ln 2 = 0.693), the maximum work obtainable from the body by interacting with the atmosphere is

(a) 150 kJ (b) 142 k J
(c) 184.2 kJ (d) 190.5 kJ

**81.** An electric current of 1 amp flows through a resistor of 300 ohm, which is in contact with a reservoir at 300 K. At steady state, the rate of entropy generation of the universe is

(a) 1 W/K (b) 2 W/K
(c) 1.5 J/K (d) 1 J/K

**82.** A liquid of heat capacity $C_p$ is stirred in an insulated container and its temperature increases from 27°C to 36°C. The entropy generation of the universe at steady state is

(a) $C_p$ ln 2 (b) $C_p$ ln 1.03
(c) $C_p/2$ (d) 0.85 $C_p$

**83.** There is no entropy transfer from a system to its surroundings

(a) by heat transfer (b) by mass transfer
(c) by heated mass transfer (d) by work transfer

**84.** The concept of which of the following provides a useful measure of energy quality?

(a) Entropy (b) Exergy
(c) Enthalpy (d) Internal energy

**85.** Second law emphasises the fact that energy always degrades

(a) quantity wise (b) quality wise
(c) adiabatically (d) irreversibly

**86.** Choose the incorrect statement.

(a) All spontaneous processes are accompanied by entropy generation.
(b) All spontaneous processes involve exergy loss.
(c) All spontaneous processes are reversible.
(d) All spontaneous processes terminate at the dead state.

**87.** The rate of exergy loss in a process is proportional to the rate of entropy generations. This theorem is called after

(a) Gouy–Stodola (b) Keenan
(c) Darrius (d) Richard Gaggiolie

**88.** Second law efficiency $\eta_{II}$ is related to the first law efficiency $\eta_I$ by the expression

(a) $\eta_I = \frac{\eta_{II}}{\eta_{Carnot}}$ (b) $\eta_{II} = \frac{\eta_I}{\eta_{Carnot}}$

(c) $\eta_{II} = \eta_I \times \eta_{Carnot}$ (d) $\eta_{II} = \eta_I + \eta_{Carnot}$

**89.** A system which is in equilibrium with its surroundings is said to be at the dead state having zero

(a) Energy (b) Entropy

(c) Exergy (d) Enthalpy

**90.** The difference between reversible work and the actual work in a process is not called

(a) irreversibility (b) degradation

(c) dissipation (d) non-available work

**91.** In order to determine the quality of wet steam by a separating and throttling calorimeter, the steam should be first separated and then throttled such that the final state is

(a) saturated vapour only

(b) superheated vapour only

(c) at a pressure higher than the original pressure

(d) a mixture of saturated liquid and vapour

**92.** If a pure substance in the gaseous phase is to be liquefied, the gas has to be first cooled below the

(a) critical state (b) triple point line

(c) saturated liquid line (d) saturated vapour line

**93.** The temperature at which the vapour pressure of a liquid is equal to 760 mm Hg is called the

(a) saturation temperature (b) boiling point

(c) normal boiling point (d) critical temperature

**94.** At the critical state, the difference of density of saturated liquid and that of saturated vapour is equal to

(a) unity (b) zero

(c) maximum (d) minimum

**95.** A pure substance cannot remain in liquid phase if it is below

(a) the critical state (b) the triple point

(c) saturated liquid line (d) saturated vapour line

**96.** If water is heated at the supercritical pressure (> 221.2 bar)

(a) there will be no flashing of liquid to vapour

(b) the saturation temperature is 374.15°C

(c) it will always remain in liquid phase

(d) there will be no bubble formation

**97.** Which of the following expands in volume upon freezing?

(a) Mercury (b) Alcohol

(c) Water (d) Chloroform

**98.** When the temperature of a liquid is less than the saturation temperature at the given pressure, the liquid is called
(a) saturated liquid (b) compressed liquid
(c) superheated liquid (d) frozen liquid

**99.** The isobars on Mollier diagram
(a) are parallel straight lines (b) converge gradually
(c) diverge from one another (d) are parabolic

**100.** Isotherms on Mollier diagram in the superheated region at low pressures become
(a) vertical (b) horizontal
(c) parallel (d) diverge from one another

**101.** The quality of very wet steam cannot be measured by a
(a) throttling calorimeter
(b) separating-and-throttling calorimeter
(c) electrical calorimeter
(d) bomb calorimeter

**102.** Solid, liquid and vapour phases of a pure substance exist in equilibrium at the
(a) saturated state (b) critical state
(c) triple point (d) normal boiling point

**103.** Which of the following gases has the highest value of specific heat ratio ($\gamma$)?
(a) Oxygen (b) Helium
(c) Methane (d) Carbon dioxide

**104.** When an ideal gas undergoes Joule–Kelvin expansion, its
(a) temperature decreases (b) temperature increases
(c) temperature does not change (d) pressure increases

**105.** The magnitude of which of the following quantity does not indicate the departure of a real gas from the ideal gas behaviour?
(a) compressibility factor (b) Joule–Kelvin coefficient
(c) Fugacity (d) Entropy

**106.** For real gases, $c_p = c_v$ occurs at
(a) critical temperature (b) triple point
(c) all temperatures (d) absolute zero temperature

**107.** An ideal gas at 27°C is heated at constant pressure till the volume becomes three times. The temperature of the gas will then be
(a) 81°C (b) 900°C
(c) 627°C (d) 927°C

**108.** The value of $\lim_{p \to 0} (pv)$ at a certain $T$
(a) is dependent on the nature of the gas
(b) depends only on temperature
(c) depends on pressure
(d) depends on volume

**109.** The expression for polytrophic specific heat is given by
(a) $c_n = c_v \dfrac{1-n}{\gamma-n}$ (b) $c_n = c_v \dfrac{\gamma-n}{1-n}$

(c) $c_n = c_v \dfrac{n-1}{\gamma - n}$ (d) $c_n = c_v \dfrac{\gamma - 1}{n-1}$

**110.** At very low pressures, the compressibility factor $Z$ approaches
(a) peak value (b) zero
(c) unity (d) minimum value

**111.** Which of the following states is very useful in predicting the properties of gases for which more precise data are not available, but their critical properties are known?
(a) van der Waals equation of state
(b) Beattie–Bridgeman equation of state
(c) Redlich–Kwong equation of state
(d) Generalised compressibility charts

**112.** As the pressure decreases, the deviation of the real gas from the ideal gas behaviour
(a) increases
(b) decreases
(c) does not change
(d) decrease due to the intermolecular forces.

**113.** On $T$-$s$ plot for a polytrophic process $pv^n = c$, if $n = \gamma$ the isentropic curve will be
(a) horizontal straight line (b) parabolic
(c) of negative slope (d) vertical line

**114.** When a liquid boils at constant pressure, which of the following parameters' increases?
(a) Temperature (b) Latent heat of vaporisation
(c) Entropy (d) Gibbs function

**115.** At chemical equilibrium, Gibbs function is
(a) maximum (b) minimum
(c) zero (d) always negative

**116.** For a system existing at constant volume and constant temperature, which of the following parameters is the criterion of equilibrium and stability of the system?
(a) Entropy (b) Gibbs function
(c) Helmholtz function (d) Internal energy

**117.** For a system existing at constant pressure and constant temperature, which of the following parameter is the criterion of equilibrium and stability of the system?
(a) Entropy (b) Gibbs function
(c) Helmholtz function (d) Internal energy

**118.** If for all possible variations in state of an isolated system, there is negative change in this quantity, then the system is in stable equilibrium.
(a) Entropy (b) Gibbs function
(c) Helmholtz function (d) Enthalpy

**119.** If a system is stable to small but not to large disturbances, it is said to be in
(a) neutral equilibrium
(b) unstable equilibrium
(c) stable equilibrium
(d) metastable equilibrium

**120.** A single component system existing in three phases at equilibrium, the variance is
(a) three
(b) two
(c) unity
(d) zero

**121.** For the first-order phase transition like boiling or condensation, this parameter changes
(a) specific volume
(b) pressure
(c) temperature
(d) Gibbs function

**122.** The coefficient of volume expansion for an ideal gas (b) is the reciprocal of
(a) pressure
(b) temperature
(c) volume
(d) internal energy

**123.** The isothermal compressibility ($k_T$) for an ideal gas is the reciprocal of
(a) pressure
(b) temperature
(c) volume
(d) internal energy

**124.** The relation $dU = C_v dT$ is valid for
(a) any substance in any process
(b) an ideal gas even if volume changes
(c) any process in phase change
(d) any reversible process

**125.** The slope of an isentrope on $p$-$v$ plot $\left(\frac{\partial p}{\partial V}\right)_s$ is
(a) less than
(b) greater than
(c) equal to
(d) unrelated, to the slope of an isotherm $\left(\frac{\partial p}{\partial V}\right)_T$

**126.** The region inside the inversion curve on $T$-$p$ coordinates is called the cooling region where the slopes of isenthalpes are
(a) positive
(b) negative
(c) zero
(d) first positive and then negative

**127.** When a gas is throttled, the maximum temperature drop or cooling will occur if the initial state lies on the
(a) saturation curve
(b) inversion curve
(c) constant enthalpy curve
(d) heating region

**128.** The isenthalpes of a gas on $T$-$p$ coordinates show no maxima above the
(a) critical temperature
(b) triple point temperature
(c) saturation temperature
(d) maximum inversion temperature

**129.** In the case of hydrogen and helium, the maximum inversion temperature is above the normal ambient temperature. So when the gas is throttled, there will only be
(a) cooling
(b) heating
(c) no change in temperature
(d) a change in enthalpy

**130.** To get the cooling effect for hydrogen be helium the gas is to be pre-cooled at least below the
(a) critical temperature
(b) triple point temperature
(c) maximum inversion temperature
(d) minimum inversion temperature

**131.** On the inversion curve, the value of the Joule–Kelvin coefficient is
(a) unity
(b) zero
(c) infinity
(d) positive

**132.** The vapour pressure of a liquid at any arbitrary temperature can be estimated approximately with the help of
(a) Gibbs equation
(b) Joule–Kelvin equation
(c) Clausius–Clapeyron equation
(d) Gibbs–Duhem equation

**133.** For a phase consisting of only one constituent, the chemical potential is equal to molar
(a) Gibbs function
(b) Hemholtz function
(c) enthalpy
(d) entropy

**134.** For a system to be stable, $\left(\frac{\partial p}{\partial V}\right)_T < 0$, which is the condition for
(a) thermal stability
(b) adiabatic bulk modulus being negative
(c) chemical stability
(d) mechanical stability

**135.** The basic cycle of a steam power plant consists of two reversible isobars and two reversible adiabetics. This reversible cycle is called
(a) Carnot cycle
(b) Rankine cycle
(c) Brayton cycle
(d) Stirling cycle

**136.** The rate of heat input ($Q_1$) required to produce unit work output (1 kW) in the steam cycle is called
(a) cycle efficiency
(b) steam rate
(c) heat rate
(d) heat flow rate

**137.** The work done in a steady flow process is equal to $-\int_1^2 v dp$. In the Rankine cycle, the turbine work is much greater than the pump work because
(a) the specific volume of water is much higher than that of steam
(b) the specific volume of steam is much higher than that of water
(c) the pressure drop in the turbine is much higher than that in the pump
(d) there are less irreversibilities in the turbine than in the pump

**138.** The maximum moisture content at the steam tubing exhaust is not allowed to exceed 15% or the quality to fall below 85% because of the
(a) use of high steam pressure
(b) use of high steam temperature
(c) erosion of the blades in later stages of turbine
(d) use of low condenser pressure

**139.** The ratio of the optimum reheat pressure (of the modern steam power plants) to the initial steam pressure is about
(a) 0.10 to 0.20 (b) 0.2 to 0.25
(c) 0.25 to 0.30 (d) 0.30 to 0.40

**140.** The demerit of the regenerative steam cycle is that
(a) it improves the cycle efficiency
(b) it reduces the heat rate
(c) it increases the steam rate
(d) it decreases the condenser load

**141.** If two cycles are coupled in series where heat lost by one is absorbed by the other, let $\eta_1$ and $\eta_2$ be the efficiencies of the topping and bottom cycles and $\eta$ be the overall efficiency of the combined cycle. If $\eta_1 = 0.50$ and $\eta_2 = 0.40$, then $\eta$ will be
(a) 0.90 (b) 0.80
(c) 0.70 (d) 0.60

**142.** In most steam power plants, closed feed water heaters are favoured, but one open heater is used
(a) to reduce cost
(b) to achieve better heat transfer
(c) to provide high feed water temperature
(d) to deaerate the feed water by removing the dissolved gases

**143.** The pressure at exhaust from a back pressure turbine
(a) is the saturation pressure corresponding to the temperature desired in the process heater
(b) depends on the power required to be developed by the turbine
(c) to meet the cogeneration of power and process heat (requirement)
(d) to maximise the energy utilisation

**144.** The major energy loss in a steam power plant takes place in the
(a) boiler (b) turbine
(c) condenser (d) electric generator

**145.** To summarise the effect of regeneration on steam cycle, which of the following statements is wrong?
(a) The cycle efficiency increases (b) Heat rate decreases
(c) Specific work output increases (d) Condenser load decreases

**146.** Two reversible isobars and two reversible isotherms constitute the
(a) Sterling cycle (b) Ericsson cycle
(c) Otto cycle (d) Atkinson cycle

**147.** The efficiency of the air standard Otto cycle depends on the
(a) temperature levels between which the cycle operates

(b) pressure ratio
(c) compression ratio
(d) amount of heat supplied

**148.** The efficiency of the Otto cycle is the highest for the same compression ratio if the working fluid is
(a) oxygen (b) air
(c) carbon dioxide (d) helium

**149.** For the same compression ratio and heat rejection, which of the following cycles is most efficient?
(a) Otto cycle (b) Diesel cycle
(c) Dual cycle (d) Brayton cycle

**150.** For the same maximum pressure and temperature of the cycle and for the same heat rejection, which of the following air standard cycle has the maximum efficiency?
(a) Otto cycle (b) Diesel cycle
(c) Dual cycle (d) Brayton cycle

**151.** For the same compression ratio, the efficiency of the Brayton cycle is
(a) equal to Otto cycle (b) equal to Diesel cycle
(c) equal to Dual cycle (d) greater than Diesel cycle

**152.** Two reversible isobars and two reversible adiabatics constitute the Brayton cycle. The same processes also make up the
(a) Sterling cycle (b) Ericsson cycle
(c) Otto cycle (d) Rankine cycle

**153.** In a gas turbine unit with regenerator, a perfect regeneration means
(a) $T_3 > T_5$ where $T_3$ is the temperature of air leaving the regenerator and $T_5$ is the temperature of gases leaving the turbine
(b) $T_3 < T_5$
(c) $T_3 = T_5$
(d) none of the above

**154.** The cycle comprising constant volume heat addition and constant pressure heat rejection is called the
(a) Diesel cycle (b) Otto cycle
(c) Lenoir cycle (d) Atkinson cycle

**155.** The air standard cycle involving constant pressure heat addition and constant volume heat rejection refers to the
(a) Diesel cycle (b) Otto cycle
(c) Lenoir cycle (d) Atkinson cycle

**156.** The maximum net work obtainable in an ideal Brayton cycle for $T_{max} = 900$ K and $T_{min} = 400$ K is given by
(a) 100 $c_p$ (b) 500 $c_p$
(c) 700 $c_p$ (d) 800 $c_p$

**157.** The cycle efficiency of Brayton cycle corresponding to maximum net work obtained for $T_{max} = 900$ K and $T_{min} = 400$ K is given by
(a) 55.5% (b) 40.5%
(c) 33.3% (d) 20.5%

**158.** If Brayton cycle involves infinite stages of reheating and infinite stages of intercooling, the cycle reduces to
(a) Sterling cycle (b) Ericsson cycle
(c) Otto cycle (d) Atkinson cycle

**159.** Which of the following cycles consists of two reversible constant volume lines and two reversible isotherms:
(a) Sterling cycle (b) Ericsson cycle
(c) Otto cycle (d) Atkinson cycle

**160.** If $N$ is the rpm, the number of power strokes per minute in a four-stroke engine is
(a) 2 N (b) N
(c) N/2 (d) 4 N

**161.** Volumetrio efficiency of an engine is a measure of
(a) speed of the engine
(b) power of the engine
(c) pressure rise in the cylinder
(d) breathing capacity of the engine

**162.** The compression ratio of an S.I engine is in the range of
(a) 4 to 6 (b) 6 to 8
(c) 6 to 10 (d) 10 to 14

**163.** The compression ratio in diesel engines is of the order of
(a) 5-7 (b) 7-10
(c) 10-12 (d) 14-22

**164.** For a gas turbine unit, the pressure ratio for maximum net output is given by
(a) $(T_3 / T_1)^{\frac{\gamma}{2(\gamma+1)}}$ (b) $(T_3 / T_1)^{\frac{2(\gamma+1)}{\gamma}}$
(c) $(T_3 / T_1)^{\frac{\gamma}{2(\gamma+1)}}$ (d) $(T_3 / T_1)^{\frac{2\gamma}{(\gamma-1)}}$

where $T_3$ = maximum temperature, $T_1$ = minimum temperature of the cycle.

**165.** Commercial airplanes save fuel by flying at high altitudes during long trips since
(a) more thrust is produced at high altitudes
(b) air is of less density at high altitudes
(c) larger drag force is exerted on the aircraft
(d) air is of higher density at high altitudes

**166.** In a vapour compression refrigeration plant, if the condenser temperature increases, the power input to the compressor will
(a) decrease (b) increase
(c) remain the same (d) be unpredictable

**167.** In a vapour compression system, the refrigerant is superheated vapour at inlet to
(a) evaporator (b) condenser
(c) compressor (d) expansion value

**168.** The effects of superheating of vapour in the evaporator and subcooling of condensate in the condenser
(a) decrease the COP
(b) increase the COP
(c) superheating increases COP, but subcooling decreases COP
(d) superheating decreases COP, but subcooling decreases COP

**169.** One tonne of refrigeration is approximately equal to the heat removal rate of
(a) 200 kJ/min (b) 2 kW
(c) 3.5 kW (d) 12000 kJ/h

**170.** It is not a cause for discouragement of the use of chlorofluorocarbon (CFC) refrigerants in domestic refrigerators and air conditioners for
(a) their ozone depletion potential
(b) their global warming potential
(c) their tendency to migrate to the upper atmosphere by molecular diffusion
(d) their toxicity and non-availability

**171.** A good refrigerant in a v.c. cycle should have a
(a) large latent heat at condensing pressure
(b) large latent heat at evaporator pressure
(c) condensing pressure closer to critical pressure
(d) low critical pressure

**172.** In an aircraft refrigeration system, the pressure at the cooling turbine outlet is equal to
(a) ambient pressure
(b) pressure at inlet to the compressor
(c) cabin pressure
(d) pressure at inlet the control value

**173.** Upgradation of low grade reject heat is done by
(a) a steam jet (b) an electric heater
(c) a heat pump (d) a cascade refrigerator

**174.** In gas cycle refrigeration, an engine is used, instead of a throttle value for pressure drop because
(a) enough cooling or temperature drop is not obtained by throttling
(b) there can be heating of the gas if the temperature before throttling is not below the maximum inversion temperature
(c) there is inadequate control of temperature
(d) there can be leakage of gas

**175.** The ratio of partial pressure of water vapour $p_w$ in air-vapour mixture to the saturation pressure $p_s$ of pure water at the same temperature is called
(a) specific humidity (b) relative humidity
(c) humidity ratio (d) degree of saturation

**176.** The mass of moisture per unit mass of dry air in a mixture of air and water-vapour is called
(a) specific humidity (b) relative humidity
(c) saturated air (d) degree of saturation

**177.** A humidification process means

(a) a decrease in relative humidity
(b) an increase in specific humidity
(c) a decrease in temperature
(d) an increase in moisture

**178.** When air is adiabatically saturated, the temperature attained is
(a) dew point temperature
(b) dry bulb temperature
(c) wet bulb temperature
(d) air saturation temperature

**179.** In an adiabatic saturation process, which of the following remains constant?
(a) Enthalpy
(b) Temperature
(c) Specific humidity
(d) Relative humidity

**180.** The saturation temperature at the partial pressure of water vapour in the air-water vapour mixture is called
(a) dry bulb temperature
(b) wet bulb temperature
(c) dew point temperature
(d) air saturation temperature

**181.** The ratio of actual specific humidity and the maximum specific humidity, both at the same temperature is called
(a) humidity ratio
(b) degree of saturation
(c) relative humidity
(d) moisture-dry air ratio

**182.** In chemical dehumidification, the dry bulb temperature of air
(a) increases
(b) decreases
(c) does not change
(d) approaches dew point temperature

**183.** The minimum temperature to which water can be cooled in a cooling tower is
(a) the dry bulb temperature of the inlet air
(b) the wet bulb temperature of ambient air
(c) the dew point temperature
(d) the air saturation temperature

**184.** While water is cooled in the cooling tower, air is
(a) heated and humidified
(b) also cooled and humidified
(c) cooled and dehumidified
(d) heated and dehumidified

**185.** Air may be cooled or heated, humidified or dehumidified, or simply adiabatically saturated when air is made to flow over
(a) an evaporator coil
(b) condenser tubes
(c) a heat exchanger
(d) an air washer

**186.** The heat of reaction $\Delta H$ related to the equilibrium is given by

$$\frac{d}{dT} \ln K = \frac{\Delta H}{\bar{R}T^2}$$

This is known as
(a) Gibbs equation
(b) Helmholtz equation
(c) Van't Hoff equation
(d) Nernst equation

**187.** If the heat of reaction is negative, the reaction is said to be
(a) exothermic
(b) endothermic
(c) isothermal
(d) adiabatic

**188.** The enthalpy of formation of elements at the standard state of 1 atm, 298 K is equal to
(a) unity
(b) zero
(c) 200 kJ/kgmole
(d) 298 kJ/kgmol

**189.** The adiabatic flame temperature of a reaction is controlled by
(a) pressure regulation
(b) changing the masses of reactants
(c) the amount of excess air supplied
(d) changing the reactor volume

**190.** The lower heating value of a fuel is the heat transferred in the reaction when $H_2O$ in the products is
(a) in the vapour phase
(b) in the liquid phase
(c) in the solid phase
(d) absent

**191.** The discharge through a convergent-divergent nozzle is maximum when sonic velocity occurs
(a) at exit from the nozzle
(b) at the throat
(c) in the divergent section
(d) when the velocity at nozzle inlet is supersonic

**192.** When the inlet velocity to the nozzle is supersonic, as flow area increases
(a) pressure decrease and velocity increases
(b) pressure increase and velocity decreases
(c) pressure and velocity both decrease
(d) mass flow decreases

**193.** Shocks can occur
(a) anywhere in the convergent divergent nozzle
(b) in the convergent section
(c) in the divergent section when the flow is supersonic
(d) in the divergent section when the flow is subsonic

**194.** Shocks can occur only when the flow is supersonic and after the shocks, the
(a) flow remains supersonic
(b) flow becomes subsonic
(c) flow is sonic
(d) fluid velocity continuously increases till the exit

**195.** For compressible fluid flow, the line representing the locus of points with the same mass velocity and stagnation enthalpy is called a
(a) Fanno line
(b) Rayleigh line
(c) constant entropy line
(d) constant enthalpy line

**196.** In compressible fluid flow, the line representing the locus of states with the same impulse pressure and mass velocity is called a
(a) Fanno line
(b) Rayleigh line
(c) constant entropy line
(d) constant Mach number line

**197.** The end states $x$ and $y$ of the shock must lie in the intersection of which of the following lines on $h$-$s$ coordinates?
(a) Fanno line and Rayleigh line

(b) Fanno line and constant entropy line
(c) Constant entropy and constant enthalpy lines
(d) Rayleigh line and constant enthalpy line

**198.** The Rayleigh line is a model for compressible fluid flow in a constant area duct without friction but with
(a) momentum transfer
(b) mass transfer
(c) mass and heat transfer
(d) heat transfer

**199.** For adiabatic flow with friction in a constant area duct, whether the flow is subsonic or supersonic, the frication tends to drive the flow to the
(a) point of maximum entropy
(b) sonic point
(c) critical point
(d) point of minimum Gibbs function

**200.** If the inlet velocity of a fluid to an insulated nozzle is negligibly small, and the enthalpy drop across it is 80 kJ/kg, the velocity at exit from the nozzle is
(a) 100 m/s
(b) 200 m/s
(c) 400 m/s
(d) 600 m/s

**201.** Only those processes are possible in nature for which the entropy change of the universe is
(a) zero
(b) positive
(c) negative
(d) none of the above

**202.** The overall efficiency of a steam power plant is expressed as the product of efficiencies of its components. If the boiler efficiency takes care of the energy loss in the boiler, the cycle efficiency takes care of the energy loss in the
(a) turbine
(b) condenser
(c) electric generator
(d) auxillaries

**203.** The maximum amount of useful work that can be obtained from a system as it undergoes a process between two specified states is called
(a) exergy
(b) reversible work
(c) ideal work
(d) availability

**204.** In a Kelvin scale, which of the following plays the role of thermometric property?
(a) Length
(b) Resistance
(c) Q
(d) Thermal emf

**205.** When a rotating flywheel is brought to rest by the application of a brake, the macroscopic kinetic energy of the flywheel is converted to
(a) molecular internal energy
(b) heat
(c) zero work
(d) enthalpy rise

**206.** Heat transfer is reversible if the temperature difference is
(a) finite
(b) infinite
(c) zero
(d) none of the above

**207.** Which of the following has an important effect on reversibility of a process
(a) Time
(b) Finite gradient
(c) Dissipative effect
(d) All of the above

**208.** A large body of infinite thermal capacity which is capable of absorbing or rejecting an unlimited quantity of heat without suffering appreciable changes in its temperature is called
(a) infinite reservoir (b) source
(c) sink (d) thermal energy reservoir

**209.** A physical characteristic of an arbitrarily chosen body which changes with changes in temperature is selected to obtain a quantitative measure of temperature. The reference body is called the thermometer and the selected characteristic is called the
(a) thermal property (b) thermodynamic property
(c) thermometric property (d) None of the above

**210.** Once in thermodynamic equilibrium, the properties of the system do not vary with
(a) space coordinates (b) time
(c) elevation of configuration (d) All of the above

**211.** When a real gas is throttled, the change in temperature can be known from the
(a) Law of corresponding states
(b) Joule–Kelvin coefficient
(c) Compressibility factor
(d) Generalised compressibility chart

**212.** The 'Law of corresponding states' can be derived from the
(a) van der Waals equation (b) Berthelot equation
(c) Redlich–Kwong equation (d) All of the above

**213.** For the first-order phase transition at constant $T$ and $P$, the Gibbs function
(a) increases (b) decreases
(c) changes discontinuously (d) remains constant

**214.** In which of the following processes for an ideal gas, the heat transfer is completely converted to work?
(a) Reversible adiabatic process
(b) Reversible isothermal process
(c) Reversible isochoric process
(d) Reversible isobaric process

**215.** Which of the following is an intensive property of a system?
(a) Density (b) Viscosity
(c) Specific volume (d) Energy

**216.** A domestic refrigerator of 0.75 tonne capacity is found to have a COP of 7.5. It's power consumption is
(a) 750 W (b) 550 W
(c) 350 W (d) 150 W

**217.** At what depth below the free surface of oil having a density of 784 kg/m$^3$ will the pressure be equal to 1 bar?
(a) 10 m (b) 14 m
(c) 13 m (d) 7.84 m

**218.** The change of entropy with a change in volume at constant temperature is equal to

(a) $\left(\frac{\partial p}{\partial T}\right)_v$ (b) $\left(\frac{\partial v}{\partial T}\right)_p$

(c) $-\left(\frac{\partial T}{\partial v}\right)_p$ (d) $-\left(\frac{\partial s}{\partial P}\right)_T$

**219.** On a $p$-$v$ plane for a pure substance in superheated region, the slopes of constant temperature lines are

(a) positive (b) negative

(c) zero (d) infinite

**220.** A Carnot engine operates between a source and a sink. If 40 % of heat absorbed is rejected at 27°C, what will be the source temperature?

(a) 67°C (b) 227°C

(c) 477°C (d) 750°C

**221.** A vapour compression refrigeration cycle has a COP of 4 and extracts 10 kJ of heat from the cold reservoir. If the machine is worked as a heat pump, how much heat will it deliver to the environment?

(a) 2 kJ (b) 2.5 kJ

(c) 12.5 kJ (d) 25 kJ

**222.** In any thermodynamic plot in $p$-$v$ coordinates, all processes for a substance must have

(a) positive slope, $\frac{dp}{dv} > 0$ (b) negative slope, $\frac{dp}{dv} < 0$

(c) zero slope, $\frac{dp}{dv} = 0$ (d) none of the above

**223.** No process can be drawn for a substance on $T$-$s$ diagram for which

(a) the slope $\frac{dT}{ds} > 0$ (b) $\frac{dT}{ds} < 0$

(c) $\frac{dT}{ds} = 0$ (d) none of the above

**224.** All spontaneous processes of a system must terminate at the dead state where for the universe

(a) $S = S_{max}$ (b) $S = S_{min}$

(c) $S = 0$ (d) $S > S_{max}$

**225.** The exergy of a finite body of heat capacity $C_p$ at temperature $T$ in a given environment at $T_o$ is equal to

(a) $C_p (T - T_o)$ (b) $C_p\left[(T - T_o) - T_o \ln \frac{T}{T_o}\right]$

(c) $C_p\left[(T - T_o) + T_o \ln \frac{T}{T_o}\right]$ (d) $C_p\left[(T - T_o) - T \ln \frac{T}{T_o}\right]$

**226.** An absolute zero temperature, a reversible adiabatic line is also an

(a) isothermal line (b) isobaric line

(c) isochoric line (d) isenthalpic line

**227.** The cycle integral of this is not zero

(a) $\oint dp$ (b) $\oint dt$

(c) $\oint dh$ (d) $\oint dQ$

**228.** The sonic velocity in air at 900 K is

(a) 30 m/s (b) 300 m/s

(c) 500 m/s (d) 600 m/s

**229.** The sonic velocity in an incompressible fluid is

(a) zero (b) 800 m/s

(c) 1000 m/s (d) infinity

**230.** The maximum velocity of a compressible fluid in a converging duct is

(a) sonic (b) transonic

(c) supersonic (d) hypersonic

**231.** If the inlet velocity of a compressible fluid to a duct is sonic and the back pressure is low enough, to further increase the velocity, the duct must be

(a) converging (b) diverging

(c) converging-diverging (d) of constant diameter

**232.** Air conditioning means control of

(a) DBT (b) RH

(c) velocity and purity of air (d) All of the above

**233.** A condenser of a refrigeration system rejects 120 kW heat, while the power supplied is 30 kW. The COP of the system is

(a) 2 (b) 3

(c) 4 (d) 5

## Answers

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. (a) | 2. (c), | 3. (b), | 4. (b), | 5. (d), | 6. (c), | 7. (d) |
| 8. (c), | 9. (c), | 10. (a), | 11. (c), | 12. (b), | 13. (d), | 14. (d) |
| 15. (a) | 16. (b) | 17. (b), | 18. (c), | 19. (b) | 20. (a), | 21. (b), |
| 22. (d), | 23. (b), | 24. (c), | 25. (b), | 26. (a), | 27. (c), | 28. (b), |
| 29. (c) | 30. (a), | 31. (d), | 32. (a), | 33. (a), | 34. (c), | 35. (b), |
| 36. (b), | 37. (b), | 38. (a), | 39. (b), | 40. (b), | 41. (a), | 42. (c), |
| 43. (d), | 44. (b), | 45. (a), | 46. (d), | 47. (c), | 48. (b), | 49. (c) |
| 50. (c), | 51. (b), | 52. (b), | 53. (b), | 54. (a), | 55. (c) | 56. (c), |
| 57. (b), | 58. (c), | 59. (c), | 60. (d), | 61. (d), | 62. (a), | 63. (b), |
| 64. (a) | 65. (b), | 66. (c), | 67. (b), | 68. (c), | 69. (b), | 70. (c), |
| 71. (d), | 72. (a), | 73. (b), | 74. (d), | 75. (b), | 76. (b), | 77. (a), |
| 78. (c), | 79. (b), | 80. (c), | 81. (a), | 82. (b), | 83. (d), | 84. (b), |
| 85. (b), | 86. (c), | 87. (a), | 88. (b), | 89. (c), | 90. (d), | 91. (b), |
| 92. (a), | 93. (c), | 94. (b), | 95. (b), | 96. (d), | 97. (c), | 98. (b), |

| | | | | | | |
|---|---|---|---|---|---|---|
| 99. (c), | 100. (b), | 101. (a), | 102. (c), | 103. (b), | 104. (c), | 105. (d), |
| 106. (d), | 107. (c), | 108. (b), | 109. (b), | 110. (c), | 111. (d), | 112. (b), |
| 113. (d), | 114. (c), | 115. (b), | 116. (c), | 117. (b), | 118. (a), | 119. (d), |
| 120. (d), | 121. (a), | 122. (b), | 123. (a), | 124. (b), | 125. (b), | 126. (a), |
| 127. (b), | 128. (d), | 129. (b), | 130. (c), | 131. (b), | 132. (c), | 133. (a), |
| 134. (a), | 135. (b), | 136. (c), | 137. (b), | 138. (c), | 139. (b), | 140. (c), |
| 141. (c), | 142. (d), | 143. (a), | 144. (c), | 145. (c), | 146. (b), | 147. (c), |
| 148. (d), | 149. (a), | 150. (b), | 151. (a), | 152. (d), | 153. (c), | 154. (d), |
| 155. (a), | 156. (a), | 157. (c), | 158. (b), | 159. (a), | 160. (c), | 161. (d), |
| 162. (c), | 163. (d), | 164. (c), | 165. (b), | 166. (b), | 167. (b), | 168. (b), |
| 169. (c), | 170. (d), | 171. (b), | 172. (c), | 173. (c), | 174. (a), | 175. (b), |
| 176. (a), | 177. (b), | 178. (c), | 179. (a), | 180. (c), | 181. (b), | 182. (a), |
| 183. (b), | 184. (a), | 185. (d), | 186. (c), | 187. (a), | 188 (b), | 189. (c), |
| 190. (a), | 191. (b), | 192. (a), | 193. (c), | 194. (b), | 195. (a), | 196. (b), |
| 197. (a), | 198. (d), | 199. (b), | 200. (c), | 201. (b), | 202. (b), | 203. (b), |
| 204. (c), | 205. (a), | 206. (c), | 207. (a), | 208. (d), | 209. (c), | 210. (d), |
| 211. (b), | 212. (d), | 213. (d), | 214, (b), | 215. (c), | 216. (c), | 217. (c), |
| 218. (a), | 219. (b), | 220. (c), | 221. (c), | 222. (b), | 223. (b), | 224. (a), |
| 225. (b), | 226. (a), | 227. (d), | 228. (d), | 229. (d), | 230. (a) | 231. (b), |
| 232. (d), | 233. (b) | | | | | |