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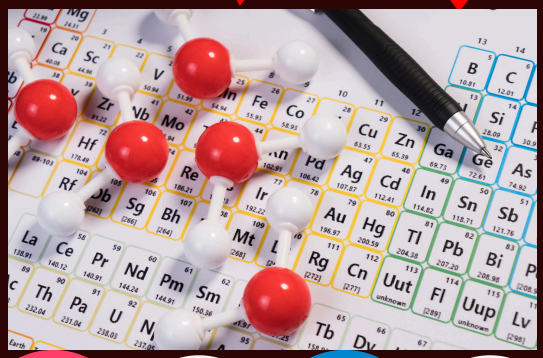

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Chapter 1: Biomolecules

1. Carbohydrates are chemically defined as:
A) Polyhydroxy acids
B) Polyhydroxy aldehydes or ketones
C) Hydrocarbons with oxygen
D) Nitrogen-containing compounds
Correct Answer: (B)

2. The empirical formula $C_6H_{12}O_6$ initially led to carbohydrates being called:
A) Alcohols
B) Carbon hydrates
C) Polyols
D) Glycols
Correct Answer: (B)

3. Monosaccharides are carbohydrates that:
A) Contain nitrogen
B) Cannot be hydrolyzed further
C) Are always polymers
D) Contain peptide bonds
Correct Answer: (B)

4. Glucose is classified as:
A) Ketohexose
B) Aldohexose
C) Aldopentose
D) Ketopentose
Correct Answer: (B)

5. Photosynthesis converts CO_2 and H_2O into glucose using:
A) Heat energy
B) Electrical energy
C) Solar energy
D) Nuclear energy
Correct Answer: (C)

6. Cellulose is a:
A) Monosaccharide
B) Disaccharide
C) Polysaccharide
D) Oligosaccharide
Correct Answer: (C)

7. Humans cannot digest cellulose due to lack of:
A) Lipase
B) Amylase
C) Cellulase
D) Protease
Correct Answer: (C)

8. Sucrose is composed of:
A) Glucose + glucose
B) Glucose + fructose
C) Fructose + fructose
D) Galactose + glucose
Correct Answer: (B)

9. Lipids are defined based on:
A) Structure
B) Functional groups
C) Solubility
D) Molecular weight
Correct Answer: (C)

10. Lipids are soluble in:
A) Water
B) Polar solvents
C) Nonpolar solvents
D) Ionic solutions
Correct Answer: (C)

11. Fats and oils are chemically:
A) Alcohols
B) Esters
C) Amines
D) Ketones
Correct Answer: (B)

12. Triacylglycerols are esters of:
A) Ethanol
B) Glycerol
C) Methanol
D) Propanol
Correct Answer: (B)

13. Fatty acids usually contain:
A) Odd number of carbons
B) Even number of carbons
C) Nitrogen atoms
D) Aromatic rings
Correct Answer: (B)

14. Unsaturated fatty acids contain:
A) Triple bonds
B) Double bonds
C) Ionic bonds
D) Hydrogen bonds
Correct Answer: (B)

15. Hydrolysis of fats with NaOH produces:
A) Alcohol + aldehyde
B) Glycerol + sodium salts of fatty acids (soaps)
C) Ketone + acid
D) Ester + alcohol
Correct Answer: (B)

16. Waxes are esters of:
A) Short-chain acids and alcohols
B) Long-chain acids and alcohols
C) Aromatic acids
D) Amino acids
Correct Answer: (B)

17. Cholesterol belongs to which class:
A) Terpenoids
B) Steroids
C) Phospholipids
D) Waxes
Correct Answer: (B)

18. Lipids without ester linkages are:
A) Hydrolyzable
B) Non-hydrolyzable
C) Oxidizable
D) Ionizable
Correct Answer: (B)

19. Amino acids contain:
A) Only amino group
B) Only carboxyl group
C) Both amino and carboxyl groups
D) Only hydroxyl group
Correct Answer: (C)

20. At physiological pH, amino acids exist as:
A) Neutral molecules
B) Cations
C) Anions
D) Zwitterions
Correct Answer: (D)

21. Zwitterions have:
A) Only positive charge
B) Only negative charge
C) Both positive and negative charges
D) No charge
Correct Answer: (C)

22. Amino acids are amphiprotic because they:
A) Are hydrocarbons
B) Can act as acids and bases
C) Contain aromatic rings
D) Are insoluble
Correct Answer: (B)

23. Peptide bonds are:
A) Ester bonds
B) Amide bonds
C) Ionic bonds
D) Hydrogen bonds
Correct Answer: (B)

24. Proteins are:
A) Monosaccharides
B) Lipids
C) Polymers of amino acids
D) Nucleotides
Correct Answer: (C)

25. Enzymes are:
A) Carbohydrates
B) Lipids
C) Proteins
D) Nucleic acids
Correct Answer: (C)

26. DNA stands for:
A) Deoxynitric acid
B) Deoxyribonucleic acid
C) Dinucleic acid
D) Dinitrogen acid
Correct Answer: (B)

27. RNA contains which sugar:
A) Glucose
B) Ribose
C) Deoxyribose
D) Fructose
Correct Answer: (B)

28. DNA contains which sugar:
A) Ribose
B) Deoxyribose
C) Glucose
D) Galactose
Correct Answer: (B)

29. Nucleotides consist of:
A) Sugar + base
B) Base + phosphate
C) Sugar + base + phosphate
D) Protein + sugar
Correct Answer: (C)

30. Nucleoside consists of:
A) Sugar + phosphate
B) Sugar + base
C) Base + protein
D) Phosphate + protein
Correct Answer: (B)

31. DNA bases include:
A) Adenine, thymine, cytosine, guanine
B) Adenine, uracil, cytosine
C) Guanine, uracil
D) Thymine only
Correct Answer: (A)

32. RNA differs from DNA by having:
A) Thymine
B) Uracil
C) Cytosine
D) Guanine
Correct Answer: (B)

Chapter 2: Chromatography

1. The term "chromatography" is derived from Greek words meaning:
A) Color separation
B) Color writing
C) Mixture analysis
D) Pigment study
Correct Answer: (B)

2. Who is credited with the invention of chromatography in 1903?
A) Archer Martin
B) Richard Synge
C) Mikhail Tswett
D) James Lovelock
Correct Answer: (C)

3. What did Mikhail Tswett separate in his original chromatography experiment?
A) Amino acids
B) Plant pigments (chlorophylls and xanthophylls)
C) Proteins
D) Carbohydrates
Correct Answer: (B)

4. The stationary phase in chromatography is defined as:
A) The phase that moves through the system
B) The phase that is fixed in place
C) The sample being analyzed
D) The detector response
Correct Answer: (B)

5. The mobile phase in chromatography is defined as:
A) The phase that is fixed in place
B) The phase that moves in a definite direction
C) The solid support material
D) The sample injection port
Correct Answer: (B)

6. In chromatography, separation of components is primarily based on:
A) Differential migration due to differences in affinity for the two phases
B) Differences in molecular weight only
C) Differences in boiling point only
D) Differences in color only
Correct Answer: (A)

7. The process of washing components through a column by mobile phase flow is called:
A) Adsorption
B) Partition
C) Elution
D) Migration
Correct Answer: (C)

8. The graphical output showing detector response versus time is called:
A) Electropherogram
B) Chromatogram
C) Spectrogram
D) Diffractogram
Correct Answer: (B)

9. Retention time (tR) is defined as:
A) The time taken for solvent front to reach the detector
B) The time taken for a specific analyte to elute from the column after injection
C) The total time of analysis
D) The time between sample preparation and injection
Correct Answer: (B)

10. Which scientists received the Nobel Prize in 1952 for developing partition chromatography?
A) Kuhn and Lederer
B) Martin and Synge
C) Tswett and Martin
D) Synge and Kuhn
Correct Answer: (B)

11. In chromatography, a component with higher affinity for the stationary phase will:
A) Move quickly through the column
B) Spend more time in the stationary phase and move slowly
C) Elute before other components
D) Have a higher Rf value
Correct Answer: (B)

12. The substance(s) to be separated and analyzed in chromatography is/are called:
A) Eluent
B) Mobile phase
C) Analyte
D) Stationary phase
Correct Answer: (C)

13. Gas-Solid Chromatography (GSC) is classified based on:
A) Separation mechanism
B) Physical state of phases
C) Bed shape
D) Development procedure
Correct Answer: (B)

14. Liquid-Liquid Chromatography (LLC) is a type of:
A) Adsorption chromatography
B) Partition chromatography
C) Size exclusion chromatography
D) Ion exchange chromatography
Correct Answer: (B)

15. Which classification criterion distinguishes Gas Chromatography from Liquid

Chromatography?
A) Separation mechanism
B) Physical state of the mobile phase
C) Column shape
D) Development procedure
Correct Answer: (B)

16. Planar chromatography includes which of the following techniques?
A) Column chromatography and HPLC
B) Paper chromatography and Thin Layer Chromatography
C) Gas chromatography and HPLC
D) Size exclusion and affinity chromatography
Correct Answer: (B)

17. In column chromatography, the stationary phase is held within:
A) A flat plate
B) A narrow tube (column)
C) Paper fibers
D) A rotating disk
Correct Answer: (B)

18. The method where the sample mixture itself is used as the mobile phase is called:
A) Elution development
B) Frontal analysis
C) Displacement development
D) Gradient elution
Correct Answer: (B)

19. In displacement development, a displacer has:
A) Low affinity for stationary phase
B) High affinity for stationary phase
C) No affinity for stationary phase
D) Equal affinity for both phases
Correct Answer: (B)

20. The most common method of development in chromatography is:
A) Frontal analysis
B) Displacement development
C) Elution development
D) Stepwise development
Correct Answer: (C)

21. In a chromatogram, the peak area is proportional to:
A) Retention time
B) Concentration of the component
C) Column temperature
D) Mobile phase viscosity
Correct Answer: (B)

22. A sharp, narrow peak in chromatography indicates:
A) Poor separation
B) Good separation efficiency
C) Column overloading
D) Detector malfunction
Correct Answer: (B)

23. The distribution of solutes between stationary and mobile phases is based on:
A) Continuous equilibrium
B) Irreversible binding
C) Chemical reaction
D) Thermal decomposition
Correct Answer: (A)

24. Components with higher affinity for mobile phase will:
A) Move slowly
B) Move quickly
C) Remain at the origin
D) Degrade during separation
Correct Answer: (B)

25. In Gas-Liquid Chromatography (GLC), the stationary phase is:
A) A solid adsorbent
B) A liquid coated on a solid support
C) A gas
D) An ion exchange resin
Correct Answer: (B)

26. Liquid-Solid Chromatography (LSC) operates on which principle?
A) Partition
B) Adsorption
C) Size exclusion
D) Ion exchange
Correct Answer: (B)

27. Which type of chromatography separates based on differential solubility?
A) Adsorption chromatography
B) Partition chromatography
C) Ion exchange chromatography
D) Size exclusion chromatography
Correct Answer: (B)

28. Affinity chromatography utilizes:
A) Non-specific adsorption
B) Highly specific biological interactions
C) Molecular sieving
D) Ion exchange
Correct Answer: (B)

29. Which technique uses a gas as mobile phase and a solid as stationary phase?
A) Gas-Liquid Chromatography
B) Gas-Solid Chromatography
C) Liquid-Liquid Chromatography
D) Liquid-Solid Chromatography
Correct Answer: (B)

30. The most common form of Gas Chromatography is:
A) Gas-Solid Chromatography
B) Gas-Liquid Chromatography
C) Gas-Adsorption Chromatography

Chapter 3: Environmental Chemistry

1. Which of the following components of the environment includes all water bodies, mainly oceans, rivers, streams, lakes, polar ice caps, glaciers, and ground water reservoirs?
A) Atmosphere
B) Lithosphere
C) Biosphere
D) Hydrosphere
Correct Answer: (D)

2. The layer of gases surrounding the earth, with a thickness of about 1000 km and consisting of N_2, O_2, Ar, CO_2, and trace gases, is known as:
A) Hydrosphere
B) Lithosphere
C) Atmosphere
D) Biosphere
Correct Answer: (C)

3. What percentage of the earth's total water resources is available as fresh water for human consumption?
A) 2%
B) 5%
C) 10%
D) 1%
Correct Answer: (D)

4. The rigid rocky crust of the earth, extending to a depth of 100 km and composed mainly of oxygen, silicon, and aluminum, is called:
A) Atmosphere
B) Hydrosphere
C) Biosphere
D) Lithosphere
Correct Answer: (D)

5. The region of the earth capable of supporting life, including the lower atmosphere, oceans, rivers, lakes, soils, and solid sediments, is termed:
A) Lithosphere
B) Ecosphere or Biosphere
C) Hydrosphere
D) Troposphere
Correct Answer: (B)

6. Which of the following is NOT considered a primary pollutant from industrial units and automobile exhaust?
A) Sulphur dioxide
B) Carbon monoxide
C) Ozone
D) Nitrogen oxides
Correct Answer: (C)

7. Carbon monoxide is a highly toxic gas because it binds with blood hemoglobin approximately how many times more strongly than oxygen?
A) 100 times
B) 500 times
C) 200 times
D) 320 times
Correct Answer: (C)

8. The major source (75%) of carbon monoxide in the atmosphere is attributed to:
A) Volcanic eruption
B) Oxidation of methane
C) Fuel burning in transportation
D) Forest fires
Correct Answer: (C)

9. The residence time of nitric oxide (NO) and nitrogen dioxide (NO_2) in the atmosphere are:
A) 4 days and 3 days respectively
B) 3 days and 4 days respectively
C) 5 days and 2 days respectively
D) 2 days and 5 days respectively
Correct Answer: (A)

10. On a global scale, most of the sulphur dioxide (SO_2) is produced by:
A) Combustion of coal
B) Petroleum industry
C) Volcanoes (67%)
D) Oxidation of organic matter
Correct Answer: (C)

11. A large quantity of methane (CH_4) is emitted into the atmosphere from:
A) Automobiles
B) Solvent evaporation
C) Paddy fields and anaerobic decomposition of organic matter
D) Petroleum refining
Correct Answer: (C)

12. The mean residence time of methane in the atmosphere is approximately:
A) 1-2 years
B) 10-15 years
C) 3-7 years
D) 20-25 years
Correct Answer: (B)

13. The pH of unpolluted rain water, due to the presence of carbonic acid, is:
A) 7.0
B) 4.5
C) 5.6
D) 6.5
Correct Answer: (C)

14. Acid deposition includes both wet and dry forms. Which of the following is a form of wet deposition?
A) Dust
B) Smoke particles
C) Snow and fog
D) Gaseous SO_2
Correct Answer: (C)

15. Which heavy metal, when leached from acidified soil and rocks, is particularly harmful to fish as it clogs their gills?
A) Mercury
B) Lead
C) Aluminum
D) Cadmium
Correct Answer: (C)

16. Reducing smog, characterized by high contents of SO_2 and a chemically reducing nature, is primarily caused by the combustion of:
A) Natural gas
B) Coal
C) Petroleum
D) Wood
Correct Answer: (B)

17. The yellowish-brownish grey haze in photochemical smog is due to the presence of:
A) Ozone
B) Carbon monoxide
C) Nitrogen dioxide
D) Peroxyacetyl nitrate (PAN)
Correct Answer: (C)

18. Peroxyacetyl nitrate (PAN), a component of photochemical smog, is primarily an:
A) Eye irritant
B) Respiratory aid
C) Nutrient for plants
D) Odorless gas
Correct Answer: (A)

19. The thickness of the ozone layer is measured in Dobson units (DU). The average total column ozone over the Earth is closest to:
A) 150 DU
B) 300 DU
C) 350 DU
D) 500 DU
Correct Answer: (B)

20. In the stratosphere, the temperature increases with altitude primarily due to the absorption of ultraviolet radiation by:
A) Nitrogen
B) Oxygen
C) Carbon dioxide
D) Ozone
Correct Answer: (D)

21. A single chloride free radical (Cl) can destroy up to how many ozone (O_3) molecules in the stratosphere?
A) 10
B) 1,000
C) 10,000
D) 100,000
Correct Answer: (D)

22. Which of the following water pollutants is known to cause infectious diseases such as dysentery, typhoid, and hepatitis?
A) Detergents
B) Heavy metals
C) Chemical and bacterial contents in livestock waste
D) Oil spillage
Correct Answer: (C)

23. Polycyclic aromatic hydrocarbons (PAHs), present in petroleum products, are known to be:
A) Non-toxic to marine life
B) Carcinogenic even at very low concentrations
C) Essential nutrients for fish
D) Readily biodegradable in water
Correct Answer: (B)

24. Detergents in waste water can mobilize bound toxic ions of heavy metals such as Pb, Cd, and Hg from sediments into water by a process of:
A) Oxidation
B) Reduction
C) Coagulation
D) Chelation or mobilization
Correct Answer: (D)

25. The drainage water from agricultural land often contains pesticides. At low concentrations, when ingested over months or years, these synthetic organic chemicals can cause:
A) Immediate nausea and dizziness
B) No adverse effects
C) Long-term health problems including cancer
D) Improved plant growth
Correct Answer: (C)

Chapter 4: Nuclear Chemistry

1. The spontaneous breaking down of unstable atoms accompanied by emission of radiation is called
A) Nuclear reaction
B) Radioactivity
C) Chemical reaction
D) Transmutation
Correct Answer: (B)

2. Who sorted out the three types of radioactive radiations in 1902?
A) Marie Curie
B) Henri Becquerel
C) Rutherford
D) Soddy
Correct Answer: (C)

3. Which type of radiation bends towards the negative plate in an electric field?
A) Alpha rays
B) Beta rays
C) Gamma rays
D) X-rays
Correct Answer: (A)

4. Which type of radiation bends towards the positive plate in an electric field?
A) Alpha rays
B) Beta rays
C) Gamma rays
D) Neutron rays
Correct Answer: (B)

5. Which type of radiation passes straight through an electric field without bending?
A) Alpha rays
B) Beta rays
C) Gamma rays
D) Both alpha and beta rays
Correct Answer: (C)

6. Alpha particles are actually
A) Electrons
B) Helium nuclei
C) Hydrogen nuclei
D) Neutrons
Correct Answer: (B)

7. The mass of an alpha particle is
A) 1 amu
B) 2 amu
C) 3 amu
D) 4 amu
Correct Answer: (D)

8. The charge on an alpha particle is
A) +1
B) -1
C) +2
D) -2
Correct Answer: (C)

9. Alpha particles can be represented as
A) $^{0}_{-1}e$
B) $^{1}_{0}n$
C) $^{4}_{2}He$
D) $^{1}_{1}H$
Correct Answer: (C)

10. The velocity of alpha particles is about
A) One-tenth the velocity of light
B) Half the velocity of light
C) Equal to the velocity of light
D) Twice the velocity of light
Correct Answer: (A)

11. Alpha particles are stopped by
A) 1 cm thick aluminium sheet
B) 1 m thick air
C) A sheet of paper
D) 5 cm thick lead sheet
Correct Answer: (C)

12. Which type of radiation causes the most intense ionization?
A) Alpha particles
B) Beta particles
C) Gamma rays
D) X-rays
Correct Answer: (A)

13. Beta particles are identical with
A) Helium nuclei
B) Protons
C) Electrons
D) Neutrons
Correct Answer: (C)

14. The mass of a beta particle is approximately
A) 4 amu
B) 1 amu
C) 1/1827 amu
D) 2 amu
Correct Answer: (C)

15. Beta particles are symbolized as
A) $^{4}_{2}He$
B) $^{1}_{1}H$
C) $^{0}_{1}\beta$ or $^{0}_{-1}e$
D) $^{0}_{0}\gamma$
Correct Answer: (C)

16. The velocity of beta particles is about
A) One-tenth the velocity of light
B) The same as the velocity of light
C) Half the velocity of light
D) Ten times the velocity of alpha particles
Correct Answer: (D)

17. Beta particles can be stopped by
A) A sheet of paper
B) 0.01 mm thick aluminium foil
C) 1 cm thick aluminium sheet
D) 5 cm thick lead sheet
Correct Answer: (C)

18. The ionizing power of beta particles compared to alpha particles is
A) Ten times more
B) One-hundredth
C) Equal
D) Ten times less
Correct Answer: (B)

19. Gamma rays are a form of
A) Particle radiation
B) Electromagnetic radiation
C) Cathode rays
D) Canal rays
Correct Answer: (B)

20. The wavelength of gamma rays compared to X-rays is
A) Longer
B) Shorter
C) Equal
D) Cannot be compared
Correct Answer: (B)

21. Gamma rays are symbolized as
A) $^{4}_{2}He$
B) $^{0}_{-1}e$
C) $^{0}_{0}\gamma$
D) $^{1}_{0}n$
Correct Answer: (C)

22. Gamma rays travel with
A) One-tenth the velocity of light
B) Half the velocity of light
C) The velocity of light
D) One-hundredth the velocity of light
Correct Answer: (C)

23. Which type of radiation has the highest penetrating power?
A) Alpha particles
B) Beta particles
C) Gamma rays
D) All have equal penetrating power
Correct Answer: (C)

24. Gamma rays are weak ionizers because
A) They have no charge
B) They have no mass
C) The chances of photon-electron collisions are small
D) All of the above
Correct Answer: (D)

25. Gamma rays can be stopped by
A) A sheet of paper
B) 1 cm thick aluminium
C) 5 cm thick lead
D) 1 m thick air
Correct Answer: (C)

26. The penetrating power of alpha particles is
A) Low
B) Moderate
C) High
D) Very high
Correct Answer: (A)

27. The penetrating power of beta particles is
A) Low
B) Moderate
C) High
D) Very high
Correct Answer: (B)

28. The penetrating power of gamma rays is
A) Low
B) Moderate
C) High
D) Very high
Correct Answer: (D)

Chapter 6: Chemical Industries

1. In the Contact Process for sulphuric acid production, the primary source of sulphur dioxide is obtained by
A) Reduction of gypsum
B) Roasting of iron pyrites or burning of elemental sulphur
C) Thermal decomposition of sulphur trioxide
D) Oxidation of hydrogen sulphide
Correct Answer: (B)

2. The catalyst used in the oxidation of sulphur dioxide to sulphur trioxide in the Contact Process is
A) Finely divided nickel
B) Vanadium pentoxide (V_2O_5)
C) Platinum black
D) Iron(III) oxide
Correct Answer: (B)

3. The optimum temperature range for the catalytic oxidation of SO_2 to SO_3 in the Contact Process is maintained between
A) 100-150°C
B) 200-300°C
C) 400-450°C
D) 550-650°C
Correct Answer: (C)

4. According to Le Chatelier's principle, the conversion of SO_2 to SO_3 is favored by
A) High temperature and high pressure
B) Low temperature and high pressure
C) Low temperature and low pressure
D) High temperature and low pressure
Correct Answer: (B)

5. In the Contact Process, the catalytic converter uses multiple beds of catalyst with inter-pass cooling to
A) Increase the pressure drop
B) Prevent the reverse reaction and optimize the yield
C) Remove sulphur impurities
D) Convert SO_3 back to SO_2
Correct Answer: (B)

6. The reaction for the formation of sulphur trioxide from sulphur dioxide and oxygen is
A) $2SO_2 + O_2 \rightleftharpoons 2SO_3$
B) $SO_2 + O_2 \rightarrow SO_3$
C) $2SO_2 + 3O_2 \rightarrow 2SO_4^{2-}$
D) $S + O_2 \rightarrow SO_3$
Correct Answer: (A)

7. The absorption of sulphur trioxide in the Contact Process is carried out in a tower using
A) Water
B) Dilute sulphuric acid
C) Concentrated sulphuric acid (98-99%)
D) Oleum
Correct Answer: (C)

8. The use of concentrated H_2SO_4 for absorbing SO_3, rather than water, prevents the formation of
A) A corrosive mist of sulphuric acid
B) Hydrogen sulphide gas
C) Solid sulphur deposits
D) Sulphur dioxide
Correct Answer: (A)

9. The acid produced by dissolving SO_3 in concentrated H_2SO_4 is called
A) Pyrosulphuric acid ($H_2S_2O_7$) or Oleum
B) Sulphurous acid (H_2SO_3)
C) Thiosulphuric acid ($H_2S_2O_3$)
D) Peroxymonosulphuric acid (H_2SO_5)
Correct Answer: (A)

10. In the purification of the roaster gas (SO_2) before it enters the catalytic converter, the gas is passed through an electrostatic precipitator to remove
A) Moisture
B) Arsenic and other particulate matter
C) Oxygen
D) Nitrogen
Correct Answer: (B)

11. The overall reaction for the production of sulphuric acid by the Contact Process from elemental sulphur can be summarized as
A) $S + O_2 + H_2O \rightarrow H_2SO_4$
B) $2S + 3O_2 + 2H_2O \rightarrow 2H_2SO_4$
C) $S + 2H_2O \rightarrow H_2SO_4 + 2H_2$
D) $S + H_2SO_4 \rightarrow SO_2 + H_2O$
Correct Answer: (Both A and B)

12. The efficiency of the Contact Process is primarily determined by the equilibrium constant (Kp) for the reaction $2SO_2 + O_2 \rightleftharpoons 2SO_3$. At 450°C, the equilibrium is shifted towards SO_3 by
A) Removing O_2 from the system
B) Increasing the temperature
C) Decreasing the pressure
D) Increasing the pressure
Correct Answer: (D)

13. In the Lead Chamber Process (an older method), the oxidation of SO_2 to H_2SO_4 was facilitated by nitrogen oxides (NO_x), which act as
A) A catalyst
B) A reactant that is consumed
C) An inhibitor
D) A dehydrating agent
Correct Answer: (A)

14. A key impurity in the pyrites (FeS_2) used in the Contact Process that poisons the vanadium catalyst is
A) Silica
B) Calcium carbonate
C) Arsenic (As) and its compounds
D) Copper pyrites
Correct Answer: (C)

15. The function of the drying tower in the Contact Process, located before the catalytic converter, is to remove
A) Sulphur dioxide
B) Water vapor
C) Nitrogen oxides
D) Carbon dioxide
Correct Answer: (B)

16. The percentage of sulphur dioxide converted to sulphur trioxide in a modern Contact Process plant is typically
A) 50-60%
B) 70-80%
C) 98-99.5%
D) 100%
Correct Answer: (C)

17. In the Ostwald Process for the manufacture of nitric acid, the initial step involves the catalytic oxidation of ammonia to
A) Nitrous oxide (N_2O)
B) Nitric oxide (NO)
C) Nitrogen dioxide (NO_2)
D) Dinitrogen trioxide (N_2O_3)
Correct Answer: (B)

18. The catalyst used in the Ostwald Process for ammonia oxidation is
A) Finely divided iron
B) Platinum-rhodium alloy gauze
C) Vanadium pentoxide
D) Nickel
Correct Answer: (B)

19. The reaction for the catalytic oxidation of ammonia in the Ostwald Process is
A) $2NH_3 + 3O_2 \rightarrow N_2 + 3H_2O$
B) $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$
C) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
D) $2NH_3 + 4O_2 \rightarrow N_2O_5 + 3H_2O$
Correct Answer: (C)

20. The temperature maintained for the oxidation of ammonia over the platinum-rhodium catalyst in the Ostwald Process is approximately
A) 200-300°C
B) 400-500°C
C) 800-900°C
D) 1000-1100°C
Correct Answer: (C)

21. The nitric oxide (NO) produced in the Ostwald Process is further oxidized to nitrogen dioxide (NO_2) according to the reaction
A) $NO + O_2 \rightarrow NO_3$
B) $2NO + O_2 \rightarrow 2NO_2$
C) $NO + NO_2 \rightarrow N_2O_3$
D) $NO + H_2O \rightarrow HNO_2$
Correct Answer: (B)

22. The absorption of nitrogen dioxide in water to form nitric acid occurs via the reaction
A) $2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$
B) $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$
C) $NO_2 + H_2O \rightarrow HNO_3 + H_2$
D) $N_2O_4 + H_2O \rightarrow HNO_3 + HNO_2$
Correct Answer: (B)

23. In the Ostwald Process, the nitric oxide (NO) that is not absorbed is recycled back to the
A) Ammonia oxidizer
B) Absorption tower
C) Oxidation chamber
D) Compressor
Correct Answer: (C)

24. The concentration of nitric acid produced by the absorption of NO_2 in water in the Ostwald Process is typically
A) 20-30%
B) 40-50%
C) 55-65%
D) 80-90%
Correct Answer: (C)

25. To obtain concentrated (98-99%) nitric acid, the weak acid from the absorption tower is subjected to
A) Simple distillation
B) Fractional distillation with a dehydrating agent like concentrated H_2SO_4
C) Vacuum evaporation
D) Freeze crystallization
Correct Answer: (B)

26. The primary raw materials for the Ostwald Process are
A) Ammonia and air
B) Nitrogen and hydrogen
C) Sodium nitrate and sulphuric acid
D) Nitric oxide and water
Correct Answer: (A)

Chapter 7: Surface Chemistry

1. Thomas Graham classified substances that passed through a permeable membrane as:
A) Colloids
B) Crystalloids
C) Emulsions
D) Gels
Correct Answer: (B)

2. The substances that did not pass through a permeable membrane in Graham's experiment were called:
A) Crystalloids
B) Electrolytes
C) Colloids
D) True solutions
Correct Answer: (C)

3. In a true solution, the diameter of dispersed particles generally lies in the range:
A) 1 Å to 10 Å
B) 10 Å to 100 Å
C) 100 Å to 1000 Å
D) 2000 Å to 5000 Å
Correct Answer: (A)

4. In a suspension, the diameter of dispersed particles is generally of the order of:
A) 10 Å
B) 100 Å
C) 500 Å
D) 2000 Å or more
Correct Answer: (D)

5. A colloidal system has dispersed particles with diameter approximately in the range:
A) 1 Å to 10 Å
B) 10 Å to 2000 Å
C) 2000 Å to 20,000 Å
D) 0.1 Å to 1 Å
Correct Answer: (B)

6. A system is classed as colloidal if at least one dimension of its particles lies in the range:
A) 1 Å to 5 Å
B) 5 Å to 10 Å
C) 10 Å to 2000 Å
D) 2000 Å to 4000 Å
Correct Answer: (C)

7. The phase distributed as colloidal particles is called the:
A) Solvent phase
B) Continuous phase
C) Dispersion medium
D) Dispersed phase
Correct Answer: (D)

8. The continuous phase in which colloidal particles are dispersed is called the:
A) Dispersed phase
B) Dispersion medium
C) Internal phase
D) Adsorbate
Correct Answer: (B)

9. A colloidal dispersion of one gas in another gas is not possible because gases form:
A) Ionic aggregates
B) Liquid droplets
C) A homogeneous molecular mixture
D) Solid aerosols
Correct Answer: (C)

10. A colloidal solution of copper in water contains copper as the:
A) Dispersion medium
B) Solvent
C) Protective colloid
D) Dispersed phase
Correct Answer: (D)

11. Water in a colloidal solution of copper in water acts as the:
A) Dispersed phase
B) Dispersion medium
C) Coagulant
D) Peptizing agent
Correct Answer: (B)

12. A colloidal system in which gas is dispersed in liquid is called:
A) Sol
B) Emulsion
C) Foam
D) Aerosol
Correct Answer: (C)

13. Whipped cream is an example of:
A) Aerosol
B) Foam
C) Sol
D) Gel

Correct Answer: (B)

14. A colloidal system in which gas is dispersed in solid is called:
A) Foam
B) Solid foam
C) Smoke
D) Sol
Correct Answer: (B)

15. Pumice stone is an example of:
A) Solid foam
B) Sol
C) Emulsion
D) Aerosol
Correct Answer: (A)

16. A colloidal system in which liquid is dispersed in gas is called:
A) Aerosol
B) Foam
C) Sol
D) Gel
Correct Answer: (A)

17. Fog is an example of:
A) Solid in gas
B) Liquid in gas
C) Gas in liquid
D) Liquid in solid
Correct Answer: (B)

18. A colloidal system in which liquid is dispersed in liquid is called:
A) Sol
B) Emulsion
C) Aerosol
D) Solid sol
Correct Answer: (B)

19. Milk is an example of:
A) Emulsion
B) Foam
C) Solid sol
D) Aerosol
Correct Answer: (A)

20. A colloidal system in which liquid is dispersed in solid is called:
A) Solid sol
B) Solid emulsion
C) Aerosol
D) Smoke
Correct Answer: (B)

21. Butter is an example of:
A) Solid sol
B) Solid emulsion
C) Smoke
D) Foam
Correct Answer: (B)

22. Smoke is a colloidal system of:
A) Liquid in gas
B) Solid in liquid
C) Solid in gas
D) Gas in solid
Correct Answer: (C)

23. Ink is an example of:
A) Sol
B) Gel
C) Foam
D) Solid foam
Correct Answer: (A)

24. Ruby glass is an example of:
A) Sol
B) Emulsion
C) Solid sol
D) Aerosol
Correct Answer: (C)

25. Colloidal solutions in water are specifically termed:
A) Alcosols
B) Benzosols
C) Hydrosols
D) Organosols
Correct Answer: (C)

26. When alcohol is the dispersion medium, the colloidal solution is called:
A) Hydrosol
B) Alcosol
C) Aerosol
D) Gel
Correct Answer: (B)

27. When benzene is the dispersion medium, the colloidal solution is called:
A) Hydrosol
B) Alcosol
C) Benzosol
D) Aerosol
Correct Answer: (C)

28. Sols are colloidal systems in which a _____ is dispersed in a _____.

Chapter 8: Organometallic Chemistry

1. Organometallic chemistry is the chemistry of compounds that contain:
A) Metal–oxygen bonds
B) Metal–nitrogen bonds
C) Metal–carbon bonds
D) Metal–halogen bonds
Correct Answer: (C)

2. Which coordination complex has octahedral geometry like $Cr(CO)_6$?
A) $[Cu(NH_3)_4]^{2+}$
B) $[Ni(H_2O)_6]^{2+}$
C) $[ZnCl_4]^{2-}$
D) $[Ag(CN)_2]^-$
Correct Answer: (B)

3. $Cr(CO)_6$ is described as having which geometry?
A) Tetrahedral
B) Square planar
C) Trigonal bipyramidal
D) Octahedral
Correct Answer: (D)

4. Which ligand is both a σ-donor and a strong π-acceptor?
A) H_2O
B) NH_3
C) CO
D) OH^-
Correct Answer: (C)

5. Which of the following is having both σ-donor and π-acceptor capability?
A) F^-
B) PPh_3
C) H^-
D) O^{2-}
Correct Answer: (B)

6. Cyclic organic ligands containing delocalized π systems commonly form which type of compounds with metals?
A) Chelate compounds
B) Sandwich compounds
C) Werner complexes
D) Aquo complexes
Correct Answer: (B)

7. Metal atoms bonded to organic ligands, especially CO, often form:
A) Ionic lattices only
B) Hydrogen bonds only
C) Metal–metal bonds
D) Peroxide bridges only
Correct Answer: (C)

8. Cluster compounds may contain how many metal atoms?
A) Only two
B) Only three
C) From two or three to many dozens
D) Exactly six
Correct Answer: (C)

9. Which of the following bond orders is reported for metal–metal bonds in cluster compounds?
A) Only single
B) Only single and double
C) Up to quadruple only
D) Single, double, triple, quadruple, and even quintuple
Correct Answer: (D)

10. A carbon-centered metal cluster is frequently called a:
A) Carbonylate
B) Carbide cluster
C) Carbene cluster
D) Carbanion cluster
Correct Answer: (B)

11. Which bond must be present for a compound to be classified strictly as organometallic?
A) Metal–nitrogen bonds
B) Metal–oxygen bonds
C) Metal–carbon bonds
D) Metal–sulfur bonds
Correct Answer: (C)

12. In practice, complexes containing which ligand are often included in organometallic chemistry even if no metal–carbon bond is present?
A) NH_3
B) NO
C) F^-
D) OH^-
Correct Answer: (B)

13. Which nonorganic ligand is specific as a donor–acceptor ligand important in organometallic chemistry?
A) H_2
B) O_2
C) Cl_2
D) F_2
Correct Answer: (A)

14. The first organometallic compound to be reported was synthesized by:
A) Mond
B) Zeise
C) Fischer
D) Wilkinson
Correct Answer: (B)

15. Zeise's salt was first synthesized in:
A) 1827
B) 1867
C) 1890
D) 1951
Correct Answer: (A)

16. Zeise obtained his yellow needle-like product after refluxing $PtCl_4$ and $PtCl_2$ in:
A) Water
B) Ethanol
C) Ether
D) Benzene
Correct Answer: (B)

17. The yellow product later called Zeise's salt was correctly asserted by Zeise to contain:
A) Acetylene
B) Benzene
C) Ethylene
D) Methane
Correct Answer: (C)

18. The presence of ethylene in Zeise's salt was conclusively verified by Birnbaum in:
A) 1827
B) 1868
C) 1898
D) 1956
Correct Answer: (B)

19. The formula of Zeise's salt is:
A) $Ni(CO)_4$
B) $K[Pt(C_2H_4)Cl_3]\cdot H_2O$
C) $Fe(C_5H_5)_2$
D) $Cr(CO)_6$
Correct Answer: (B)

20. In the anion of Zeise's salt, the platinum center is:
A) Tetrahedral
B) Square planar
C) Trigonal bipyramidal
D) Linear
Correct Answer: (B)

21. In Zeise's salt, ethylene is coordinated to platinum as a:
A) Terminal X-type ligand
B) Side-on η^2 ligand
C) Linear axial ligand
D) Bridging ligand between two Pt atoms
Correct Answer: (B)

22. The first compound synthesized containing carbon monoxide as a ligand was reported in:
A) 1827
B) 1867
C) 1890
D) 1951
Correct Answer: (B)

23. The commercially useful compound $Ni(CO)_4$ for nickel purification was reported by Mond in:
A) 1867
B) 1890
C) 1898
D) 1905
Correct Answer: (B)

24. Grignard reagents were developed from reactions between magnesium and alkyl halides performed by Barbier in:
A) 1827
B) 1868
C) 1898
D) 1956
Correct Answer: (C)

25. Grignard reagents contain which type of bond?
A) Mg–O π bond
B) Mg–C σ bond
C) Mg–N σ bond
D) Mg–Mg bond
Correct Answer: (B)

26. By 1905, the number of research papers on Grignard reagents had reached:
A) More than 20
B) More than 50
C) More than 200
D) More than 1000
Correct Answer: (C)

27. Kealy and Pauson were attempting to synthesize which compound when they discovered ferrocene?
A) Benzene
B) Fulvalene
C) Ethylene
D) Cyclooctadiene
Correct Answer: (B)

28. Ferrocene was obtained when cyclo-C_5H_5MgBr reacted with:
A) $PtCl_4$
B) $FeCl_3$
C) $NiCl_2$
D) $MnCl_2$
Correct Answer: (B)

29. The formula of ferrocene is:
A) $(C_5H_5)_2Fe$
B) $Fe(CO)_5$
C) $FeCl_3$
D) $K[Pt(C_2H_4)Cl_3]\cdot H_2O$
Correct Answer: (A)

30. Ferrocene is notable because it:
A) Decomposes instantly in air
B) Can be sublimed in air without decomposition
C) Contains no carbon
D) Is strongly ionic
Correct Answer: (B)

Chapter 9: NMR Spectroscopy

1. **Nuclear magnetic resonance (NMR) spectroscopy is primarily used to determine which structural feature of organic molecules?**
A) Molecular weight
B) Functional groups only
C) Carbon–hydrogen framework
D) Optical rotation
Correct Answer: (C)

2. **Which spectroscopic technique is considered the most valuable for structure determination in organic chemistry?**
A) Infrared spectroscopy
B) Nuclear magnetic resonance spectroscopy
C) UV spectroscopy
D) Raman spectroscopy
Correct Answer: (B)

3. **Mass spectrometry mainly provides information about:**
A) Functional groups
B) Molecular size and formula
C) Hydrogen bonding
D) Chemical shifts
Correct Answer: (B)

4. **Infrared spectroscopy is mainly used for identifying:**
A) Molecular size
B) Functional groups
C) Carbon framework
D) Isomerism
Correct Answer: (B)

5. **In NMR spectroscopy, nuclei behave as if they are:**
A) Vibrating
B) Rotating charges
C) Spinning about an axis
D) Oscillating dipoles
Correct Answer: (C)

6. **Spinning nuclei act like tiny magnets because they possess spin and positive nuclear charge.**
A) Electrically neutral
B) Positively charged
C) Negatively charged
D) Nonpolar
Correct Answer: (B)

7. **Which isotope does not exhibit nuclear spin and therefore does not show an NMR signal?**
A) ^{1}H
B) ^{13}C
C) ^{12}C
D) ^{2}H
Correct Answer: (C)

8. **In the absence of an external magnetic field, nuclear spins are:**
A) Parallel
B) Antiparallel
C) Randomly oriented
D) Perpendicular
Correct Answer: (C)

9. **When a sample is placed in a magnetic field, nuclear spins align:**
A) Only parallel
B) Only antiparallel
C) Parallel or antiparallel
D) Perpendicular
Correct Answer: (C)

10. **Which nuclear spin orientation has lower energy in a magnetic field?**
A) Antiparallel
B) Parallel
C) Perpendicular
D) Random
Correct Answer: (B)

11. **The transition of a nucleus from a lower-energy state to a higher-energy state is called:**
A) Ionisation
B) Spin flip
C) Hybridisation
D) Excitation
Correct Answer: (B)

12. **When nuclei absorb electromagnetic radiation and undergo spin flip, the phenomenon is called:**
A) Magnetic resonance
B) Nuclear magnetic resonance
C) Electron resonance
D) Molecular resonance
Correct Answer: (B)

13. **The resonance frequency of a nucleus depends on:**
A) Magnetic field strength
B) Type of nucleus
C) Electronic environment
D) All of these
Correct Answer: (D)

14. **If the magnetic field strength increases, the energy difference between spin states will:**
A) Decrease
B) Increase
C) Remain constant
D) Become zero
Correct Answer: (B)

15. **Which type of radiation is used in NMR spectroscopy?**
A) Infrared

B) Ultraviolet
C) Radiofrequency
D) Gamma rays
Correct Answer: (C)

16. **Which nuclei commonly studied in organic NMR exhibit magnetic properties?**
A) ^{1}H and ^{13}C
B) ^{12}C and ^{16}O
C) ^{16}O and ^{32}S
D) ^{12}C and ^{32}S
Correct Answer: (A)

17. **Nuclei with an odd number of protons or neutrons generally:**
A) Are nonmagnetic
B) Exhibit magnetic properties
C) Are chemically inert
D) Do not interact with magnetic fields
Correct Answer: (B)

18. **Which nucleus among the following gives an NMR signal?**
A) ^{12}C
B) ^{16}O
C) ^{32}S
D) ^{13}C
Correct Answer: (D)

19. **Electrons surrounding a nucleus create a local magnetic field that causes:**
A) Ionisation
B) Shielding
C) Bond breaking
D) Hybridisation
Correct Answer: (B)

20. **The effective magnetic field experienced by a nucleus is given by:**
A) B_effective = B_applied + B_local
B) B_effective = B_applied − B_local
C) B_effective = B_local − B_applied
D) B_effective = B_applied × B_local
Correct Answer: (B)

21. **Each peak in an NMR spectrum corresponds to:**
A) Each atom
B) Each functional group
C) Each chemically distinct nucleus
D) Each bond
Correct Answer: (C)

22. **Equivalent hydrogens in a molecule produce:**
A) Separate peaks
B) One peak
C) Two peaks
D) Broad peaks
Correct Answer: (B)

23. **Which compound shows two proton signals in ^{1}H NMR because it contains two distinct methyl groups?**
A) Methane
B) Ethane
C) Methyl acetate
D) Propane
Correct Answer: (C)

24. **In NMR spectroscopy, the horizontal axis represents:**
A) Energy
B) Intensity
C) Chemical shift
D) Absorbance
Correct Answer: (C)

25. **The vertical axis in an NMR spectrum represents:**
A) Frequency
B) Intensity of absorption
C) Chemical shift
D) Magnetic field strength
Correct Answer: (B)

26. **In NMR charts, the right side corresponds to the:**
A) Downfield region
B) Low-field region
C) Upfield region
D) Deshielded region
Correct Answer: (C)

27. **Signals appearing on the left side of the NMR chart are called:**
A) Upfield signals
B) Shielded signals
C) Downfield signals
D) Neutral signals
Correct Answer: (C)

28. **Tetramethylsilane (TMS) is used in NMR as a:**
A) Solvent
B) Catalyst
C) Reference standard
D) Reactant
Correct Answer: (C)

29. **The chemical shift of TMS is defined as:**
A) 10 ppm
B) 5 ppm
C) 1 ppm
D) 0 ppm
Correct Answer: (D)

30. **Chemical shift in NMR spectroscopy is measured in:**
A) Hertz
B) Joules
C) Parts per million
D) Tesla
Correct Answer: (C)

Chapter 10: IR , UV and Mass spectroscopy

1. Which technique is primarily used to measure the mass and molecular weight of a molecule?
A) Infrared spectroscopy
B) Mass spectrometry
C) Ultraviolet spectroscopy
D) NMR spectroscopy
Answer: Mass spectrometry

2. What are the three basic parts common to mass spectrometers described in the file?
A) Ionization source, mass analyzer, detector
B) Lamp, prism, detector
C) Sample holder, condenser, eyepiece
D) Cathode, anode, salt bridge
Answer: Ionization source, mass analyzer, detector

3. In electron-impact mass spectrometry, sample molecules are ionized by collision with what?
A) Low-energy photons
B) High-energy electrons
C) Thermal neutrons
D) Alpha particles
Answer: High-energy electrons

4. A molecule that has lost an electron during electron impact is best described as what species?
A) Anion radical
B) Cation radical
C) Neutral radical
D) Carbanion
Answer: Cation radical

5. In a magnetic-sector mass spectrometer, ions are separated according to which parameter?
A) Bond angle
B) Mass-to-charge ratio
C) Dipole moment
D) Boiling point
Answer: Mass-to-charge ratio

6. Neutral fragments in a magnetic-sector mass spectrometer are typically what?
A) Deflected strongly by the magnet
B) Sorted onto the detector
C) Lost on the walls of the pipe
D) Converted into cations
Answer: Lost on the walls of the pipe

7. When the charge on each ion is usually 1, the m/z value is numerically equal to what?
A) Its exact mass defect
B) Its molecular formula
C) Its mass
D) Its wavelength
Answer: Its mass

8. Masses up to approximately what value can be analyzed by the electron-impact magnetic-sector instrument described?
A) 250 amu
B) 2500 amu
C) 25,000 amu
D) 250,000 amu
Answer: 2500 amu

9. In a quadrupole mass analyzer, ions are filtered by passage through what arrangement?
A) Two concentric circles
B) Four parallel solid rods
C) A glass prism
D) A capillary plate
Answer: Four parallel solid rods

10. For a given oscillating field in a quadrupole analyzer, which ions reach the detector?
A) All positively charged ions
B) Only ions with the correct m/z
C) Only neutral fragments
D) Only the heaviest ions
Answer: Only ions with the correct m/z

11. In a mass spectrum, the x-axis represents what quantity?
A) Relative abundance
B) m/z value
C) Absorbance
D) Transmittance
Answer: m/z value

12. In a mass spectrum, the y-axis represents what quantity?
A) Exact mass
B) Relative abundance of ions
C) Wavelength
D) Frequency
Answer: Relative abundance of ions

13. What is the tallest peak in a mass spectrum called?
A) Parent peak
B) Isotope peak
C) Base peak
D) Fingerprint peak
Answer: Base peak

14. The peak corresponding to the unfragmented cation radical is called what?
A) Base peak
B) Molecular ion
C) Metastable ion
D) Reference peak
Answer: Molecular ion

15. In the propane spectrum described in the file, the molecular ion appears at what m/z value?
A) 29
B) 30

C) 44
D) 57
Answer: 44
16. In the propane spectrum described in the file, the base peak appears at what m/z value?
A) 15
B) 29
C) 41
D) 44
Answer: 29
17. Which statement about molecular ions in electron-impact mass spectrometry is correct according to the file?
A) They are always the base peak
B) They are never observed
C) They are often not the base peak
D) They are always the highest-intensity isotope peak
Answer: They are often not the base peak
18. Which one of the following masses would distinguish hexane, 1-hexene, and 1-hexyne by mass spectrometry alone?
A) All three have the same mass
B) 86, 84, and 82 respectively
C) 82, 84, and 86 respectively
D) 84, 86, and 88 respectively
Answer: 86, 84, and 82 respectively
19. What special advantage do double-focusing mass spectrometers provide?
A) They increase boiling point measurements
B) They provide very high mass resolution
C) They prevent all fragmentation
D) They only detect neutral species
Answer: They provide very high mass resolution
20. The mass accuracy reported for the double-focusing instruments in the file is approximately what?
A) 5 ppm
B) 50 ppm
C) 500 ppm
D) 0.5%
Answer: 5 ppm
21. Which pair of formulas is specifically cited as having the same nominal mass but distinguishable exact masses?
A) C6H6 and C6H12
B) C5H12 and C4H8O
C) C3H8 and C4H10
D) C7H8 and C8H8
Answer: C5H12 and C4H8O
22. Which exact mass is given in the file for C5H12?
A) 72.0575 amu
B) 72.0939 amu
C) 86.0000 amu
D) 98.0939 amu
Answer: 72.0939 amu
23. Which exact mass is given in the file for C4H8O?
A) 72.0939 amu
B) 72.0575 amu
C) 71.0575 amu
D) 74.0575 amu
Answer: 72.0575 amu
24. Exact mass measurements in high-resolution mass spectrometry refer to what?
A) Average atomic masses from the periodic table
B) Molecules with specific isotopic compositions
C) Only molecular ions lacking heteroatoms
D) Fragments containing carbon only
Answer: Molecules with specific isotopic compositions
25. Some compounds such as 2,2-dimethylpropane fail to show a molecular ion in EI mass spectra because they do what?
A) Undergo no ionization
B) Fragment too easily
C) Absorb infrared radiation strongly
D) Exist only as radicals
Answer: Fragment too easily
26. Soft ionization methods are useful because they do what relative to electron impact?
A) Increase fragmentation
B) Prevent or minimize fragmentation
C) Eliminate isotopes
D) Remove the need for detectors
Answer: Prevent or minimize fragmentation
27. A small M+1 peak in a mass spectrum commonly arises mainly from the presence of which isotope?
A) 2H only
B) 13C
C) 18O
D) 15N
Answer: 13C
28. What natural abundance of 13C is given in the file?
A) 0.11%
B) 1.10%
C) 11.0%
D) 0.015%
Answer: 1.10%
29. What natural abundance of deuterium is given in the file?
A) 1.10%
B) 0.15%
C) 0.015%
D) 0.0015%
Answer: 0.015%

Chapter 13: Gaseous State

1. The simplest state of matter is:
A) Solid
B) Liquid
C) Gas
D) Plasma
Correct Answer: (C)

2. Matter exists in how many fundamental states according to the given content?
A) Two
B) Three
C) Four
D) Five
Correct Answer: (C)

3. Which state of matter has neither definite shape nor definite volume?
A) Solid
B) Liquid
C) Gas
D) Plasma
Correct Answer: (C)

4. Liquids exist within a relatively narrow range of:
A) Pressure only
B) Temperature only
C) Temperature and pressure
D) Volume and mass
Correct Answer: (C)

5. Gases occupy:
A) Fixed volume
B) Fixed shape
C) Entire container volume
D) Half of the container
Correct Answer: (C)

6. The shape of a gas is:
A) Fixed
B) Independent of container
C) Same as solid
D) Same as container
Correct Answer: (D)

7. Gases have low density due to:
A) Strong forces
B) Close packing
C) Large intermolecular spaces
D) High mass
Correct Answer: (C)

8. The ability of gases to pass through small openings is called:
A) Diffusion
B) Effusion
C) Compression
D) Expansion
Correct Answer: (B)

9. Gases can be compressed because:
A) Molecules are heavy
B) Strong forces exist
C) Large empty spaces exist
D) Molecules are fixed
Correct Answer: (C)

10. Sudden expansion of gases causes:
A) Heating
B) No change
C) Cooling
D) Compression
Correct Answer: (C)

11. The cooling on expansion of gas is called:
A) Charles effect
B) Joule-Thomson effect
C) Boyle effect
D) Dalton effect
Correct Answer: (B)

12. Gas pressure is due to:
A) Weight of molecules
B) Collisions of molecules
C) Shape of container
D) Volume only
Correct Answer: (B)

13. Intermolecular forces in gases are:
A) Strong
B) Moderate
C) Weak
D) Very strong
Correct Answer: (C)

14. Liquids have:
A) Definite shape only
B) Definite volume only
C) Neither shape nor volume
D) Both shape and volume
Correct Answer: (B)

15. Density of liquids is:
A) Less than gases
B) Greater than gases
C) Equal to gases
D) Zero
Correct Answer: (B)

16. Molecules in solids exhibit:
A) Translational motion
B) Rotational motion
C) Vibrational motion
D) No motion
Correct Answer: (C)

17. Solids are non-compressible due to:
A) Weak forces
B) Large gaps
C) Tight packing

D) Low density
Correct Answer: (C)
18. SI unit of pressure is:
A) atm
B) torr
C) Pa
D) bar
Correct Answer: (C)
19. 1 atm is equal to:
A) 100 torr
B) 760 torr
C) 500 torr
D) 1000 torr
Correct Answer: (B)
20. 1 atm equals:
A) 101325 Pa
B) 100000 Pa
C) 760 Pa
D) 500 Pa
Correct Answer: (A)
21. Boyle's law relates:
A) V and T
B) P and T
C) P and V
D) n and T
Correct Answer: (C)
22. Boyle's law is valid at constant:
A) Pressure
B) Volume
C) Temperature
D) Density
Correct Answer: (C)
23. Mathematical expression of Boyle's law is:
A) PV = constant
B) V/T = constant
C) P/T = constant
D) n/V = constant
Correct Answer: (A)
24. If pressure doubles, volume becomes:
A) Double
B) Half
C) Same
D) Zero
Correct Answer: (B)
25. Graph of P vs V for Boyle's law is:
A) Straight line
B) Hyperbola
C) Parabola
D) Circle
Correct Answer: (B)
26. A gas sample is completely described by how many measurable parameters?

A) Two
B) Three
C) Four
D) Five
Correct Answer: (C)
27. The four measurable parameters of a gas are volume, pressure, temperature, and:
A) Density
B) Number of moles
C) Viscosity
D) Surface tension
Correct Answer: (B)
28. The volume of a gas sample is equal to the volume of its:
A) Molecules
B) Walls
C) Container
D) Manometer
Correct Answer: (C)
29. The commonly used unit for gas volume is:
A) Joule
B) Litre
C) Pascal
D) Torr
Correct Answer: (B)
30. One litre is equal to:
A) 100 mL
B) 500 mL
C) 1000 mL
D) 10,000 mL
Correct Answer: (C)
31. One millilitre is equal to:
A) 10^{-1} L
B) 10^{-2} L
C) 10^{-3} L
D) 10^{-4} L
Correct Answer: (C)
32. One millilitre is practically equal to:
A) One cubic metre
B) One cubic centimetre
C) One decimetre
D) One cubic inch
Correct Answer: (B)
33. The SI unit of volume is:
A) Litre
B) Millilitre
C) Cubic metre
D) Cubic centimetre
Correct Answer: (C)
34. The SI-related unit equivalent to one litre is:
A) cm^3
B) dm^3
C) mm^3
D) $Å^3$
Correct Answer: (B)

Chapter 14: Liquid State

1. According to kinetic molecular theory, the kinetic energy of liquid molecules at a given temperature is
A) Greater than solids and greater than gases
B) Greater than solids and lesser than gases
C) Lesser than solids and greater than gases
D) Equal to solids and gases
Correct Answer: (B)

2. The intermolecular forces in liquids are
A) Stronger than solids and weaker than gases
B) Weaker than solids and stronger than gases
C) Equal to solids and gases
D) Negligible as compared to solids
Correct Answer: (B)

3. Which of the following explains why liquids have definite volume but no definite shape?
A) Molecules are far apart with negligible forces
B) Molecules are close together but can slide over each other
C) Molecules are fixed in position with strong forces
D) Molecules have no motion at all
Correct Answer: (B)

4. The diffusion in liquids occurs slowly due to
A) Large empty spaces between molecules
B) High kinetic energy of molecules
C) Intermolecular attractive forces and small empty spaces
D) Complete absence of intermolecular forces
Correct Answer: (C)

5. Liquids cannot be compressed significantly because
A) Molecules have high kinetic energy
B) There is very little empty space among molecules
C) Intermolecular forces are negligible
D) Molecules are in constant random motion
Correct Answer: (B)

6. The expansion of liquids when heated is greater than that of solids because
A) Liquids have weaker intermolecular forces
B) Liquids have no definite shape
C) Solids have stronger intermolecular forces
D) Both A and C
Correct Answer: (D)

7. The observed expansion of a liquid when heated in a container without considering container expansion is called
A) Absolute expansion
B) Real expansion
C) Apparent expansion
D) Volume expansion
Correct Answer: (C)

8. The total expansion of a liquid including container expansion is termed as
A) Apparent expansion
B) Absolute expansion
C) Linear expansion
D) Surface expansion
Correct Answer: (B)

9. The intermolecular forces are collectively called Van der Waals forces after
A) Isaac Newton
B) Johannes Diderik van der Waals
C) Fritz London
D) Friedrich Reinitzer
Correct Answer: (B)

10. The correct order of strength of intermolecular forces is
A) Hydrogen bonding > London forces > Dipole-dipole forces
B) Dipole-dipole forces > Hydrogen bonding > London forces
C) Hydrogen bonding > Dipole-dipole forces > London forces
D) London forces > Dipole-dipole forces > Hydrogen bonding
Correct Answer: (C)

11. The attractive forces between the positive pole of one polar molecule and negative pole of another polar molecule are called
A) London forces
B) Dipole-dipole forces
C) Hydrogen bonding
D) Ion-dipole forces
Correct Answer: (B)

12. In HCl molecule, the partial negative charge is on
A) Hydrogen atom
B) Chlorine atom
C) Both atoms equally
D) Neither atom
Correct Answer: (B)

13. Hydrogen bonding is a particularly strong form of
A) London forces
B) Dipole-dipole attraction
C) Ionic bonding
D) Covalent bonding
Correct Answer: (B)

14. Hydrogen bonding exists in molecules where hydrogen is bonded to which highly electronegative atoms?
A) Carbon, oxygen, nitrogen
B) Fluorine, oxygen, nitrogen
C) Chlorine, bromine, iodine
D) Sulfur, phosphorus, silicon
Correct Answer: (B)

15. Ethyl alcohol is miscible with water in all proportions because
A) It is non-polar
B) Its molecules can form hydrogen bonds with water
C) It has high molecular mass
D) It has low surface tension
Correct Answer: (B)

16. The spiral helix structure of proteins is stabilized by
A) Covalent bonds
B) Ionic bonds
C) Hydrogen bonds
D) Metallic bonds
Correct Answer: (C)

17. The double helix structure of DNA is stabilized by
A) Covalent bonds
B) Hydrogen bonds
C) Ionic bonds
D) Van der Waals forces
Correct Answer: (B)

18. When temperature of water is lowered below 4°C, its volume increases because
A) Molecules move faster
B) Hydrogen bonds break
C) Molecules become regularly arranged creating empty spaces
D) Intermolecular forces become weaker
Correct Answer: (C)

19. Ice floats over water because
A) Ice is heavier than water
B) Density of ice is less than water
C) Ice has no hydrogen bonding
D) Ice is at higher temperature
Correct Answer: (B)

20. The density of ice is less than water due to
A) Change in bond angles
B) Empty spaces in the structure of ice
C) Decrease in volume
D) Breaking of covalent bonds
Correct Answer: (B)

21. The spontaneous change of a liquid into its vapours at any temperature is called
A) Condensation
B) Sublimation
C) Evaporation
D) Boiling
Correct Answer: (C)

22. According to kinetic molecular theory, evaporation occurs because
A) All molecules have same kinetic energy
B) Molecules with greater kinetic energy escape from surface
C) Molecules are fixed in position
D) Intermolecular forces are absent
Correct Answer: (B)

23. In an open container at constant temperature, evaporation continues
A) Until equilibrium is reached
B) At the same rate until all liquid is converted
C) Only at the boiling point
D) Only on the surface
Correct Answer: (B)

24. The rate of evaporation depends on
A) Surface area only
B) Temperature only
C) Surface area, temperature and strength of intermolecular forces
D) Volume of container only
Correct Answer: (C)

25. The pressure exerted by vapours when rate of evaporation equals rate of condensation is called
A) Atmospheric pressure
B) Vapour pressure
C) Osmotic pressure
D) Critical pressure
Correct Answer: (B)

26. The state when rate of evaporation equals rate of condensation is called
A) Static equilibrium
B) Dynamic equilibrium
C) Chemical equilibrium
D) Phase equilibrium
Correct Answer: (B)

27. Vapour pressure of a liquid depends on
A) Amount of liquid
B) Surface area of liquid
C) Volume of container
D) Nature of liquid and temperature
Correct Answer: (D)

Chapter 15: Solids

1. The existence of matter in different physical states is due to differences in:
A) Atomic mass
B) Nuclear charge
C) Intermolecular forces
D) Electron spin
Correct Answer: (C)

2. The forces of attraction between molecules are generally:
A) Stronger than covalent bonds
B) Equal to ionic bonds
C) Much weaker than intramolecular forces
D) Independent of distance
Correct Answer: (C)

3. The intermolecular forces that exist between all atoms and molecules are called:
A) Ionic forces
B) Covalent forces
C) van der Waals forces
D) Metallic forces
Correct Answer: (C)

4. Which of the following is NOT a type of intermolecular force?
A) Dipole-dipole forces
B) Ion-dipole forces
C) Hydrogen bonding
D) Nuclear forces
Correct Answer: (D)

5. Dipole-dipole forces arise due to:
A) Equal charge distribution
B) Temporary dipoles
C) Permanent dipoles
D) Nuclear interactions
Correct Answer: (C)

6. In HCl molecule, polarity arises due to difference in:
A) Atomic size
B) Electronegativity
C) Ionization energy
D) Atomic number
Correct Answer: (B)

7. The positive end of one polar molecule attracts the negative end of another due to:
A) Ionic bonding
B) Dipole-dipole interaction
C) Covalent bonding
D) Metallic bonding
Correct Answer: (B)

8. Dipole-dipole forces are approximately how effective compared to covalent bonds?
A) 50%
B) 10%
C) 1%
D) 100%
Correct Answer: (C)

9. Dipole-dipole forces are strongest in:
A) Gases
B) Liquids
C) Solids
D) Plasma
Correct Answer: (c)

10. Which factor affects dipole-dipole interaction strength?
A) Nuclear stability
B) Distance between molecules
C) Atomic number only
D) Orbital hybridization
Correct Answer: (B)

11. Dipole-induced dipole forces are also known as:
A) London forces
B) Debye forces
C) Hydrogen bonds
D) Ionic bonds
Correct Answer: (B)

12. Dipole-induced dipole forces occur between:
A) Two polar molecules
B) Two non-polar molecules
C) Polar and non-polar molecules
D) Ions only
Correct Answer: (C)

13. In dipole-induced dipole interaction, polarity is induced due to:
A) Nuclear attraction
B) Electron repulsion
C) Distortion of electron cloud
D) Orbital overlap
Correct Answer: (C)

14. London dispersion forces arise due to:
A) Permanent dipoles
B) Temporary dipoles
C) Ionic interactions
D) Hydrogen bonding
Correct Answer: (B)

15. London forces are significant in:
A) Only polar molecules
B) Only ionic compounds
C) Non-polar molecules
D) Metals only
Correct Answer: (C)

16. Which scientist explained dispersion forces?
A) Bohr
B) Einstein
C) Fritz London
D) Dalton
Correct Answer: (C)

17. Instantaneous dipole is formed due to:
A) Fixed electrons
B) Electron movement
C) Nuclear decay
D) Proton transfer
Correct Answer: (B)

18. London forces are:
A) Permanent
B) Strong
C) Short-lived
D) Ionic
Correct Answer: (C)

19. London forces exist in:
A) Only gases
B) Only liquids
C) Only solids
D) All molecules
Correct Answer: (D)

20. Strength of London forces increases with:
A) Decreasing size
B) Increasing polarizability
C) Decreasing electrons
D) Constant volume
Correct Answer: (B)

21. Polarizability refers to:
A) Ion formation
B) Electron cloud distortion
C) Bond strength
D) Atomic mass
Correct Answer: (B)

22. Larger atoms have:
A) Lower polarizability
B) Higher polarizability
C) No polarizability
D) Constant polarizability
Correct Answer: (B)

23. Boiling points of noble gases increase down the group due to:
A) Decreasing mass
B) Increasing polarizability
C) Decreasing electrons
D) Constant size
Correct Answer: (B)

24. Which noble gas has highest boiling point?
A) He
B) Ne
C) Ar
D) Rn
Correct Answer: (D)

25. London forces increase with:
A) Smaller molecules
B) Larger electron clouds
C) Less electrons
D) Shorter chains
Correct Answer: (B)

26. Halogens are:
A) Polar molecules
B) Ionic molecules
C) Non-polar diatomic molecules
D) Metallic solids
Correct Answer: (C)

27. Among halogens, highest boiling point is of:
A) F_2
B) Cl_2
C) Br_2
D) I_2
Correct Answer: (D)

28. Hydrogen bonding occurs when hydrogen is bonded to:
A) Any atom
B) Highly electronegative atom
C) Metal
D) Noble gas
Correct Answer: (B)

29. Hydrogen bonding is stronger than:
A) Ionic bond
B) Covalent bond
C) Dipole-dipole interaction
D) Nuclear force
Correct Answer: (C)

30. Hydrogen bonding involves:
A) Proton transfer
B) Electron transfer
C) Lone pair interaction
D) Nuclear reaction
Correct Answer: (C)

31. Solids have:
A) Indefinite shape
B) Indefinite volume
C) Definite shape and volume
D) No structure
Correct Answer: (C)

Chapter 16: Ionic Equilibrium (Acid-Base)

1. An acid according to the Arrhenius concept is a substance that releases which ion in water?
A) OH^-
B) H^+
C) Cl^-
D) Na^+
Correct Answer: (B)

2. A base according to the Arrhenius concept is a substance that releases which ion in water?
A) H^+
B) Cl^-
C) OH^-
D) H_3O^+
Correct Answer: (C)

3. Which one is an Arrhenius acid?
A) NaOH
B) KOH
C) HCl
D) $Ca(OH)_2$
Correct Answer: (C)

4. Which one is an Arrhenius base?
A) HNO_3
B) HCl
C) CH_3COOH
D) NaOH
Correct Answer: (D)

5. The hydrogen ion released by an acid does not remain free in water but forms:
A) OH^-
B) H_2O_2
C) H_3O^+
D) HO_2^-
Correct Answer: (C)

6. Bases are commonly characterized by which property?
A) Sour taste
B) Bitter taste
C) Sweet taste
D) Pungent smell
Correct Answer: (B)

7. Acids are commonly associated with which property?
A) Bitter taste
B) Slippery feel
C) Sour taste
D) Soapy touch
Correct Answer: (C)

8. A soluble base dissolved in water is called:
A) Salt
B) Oxide
C) Alkali
D) Acid
Correct Answer: (C)

9. Which compound is commonly known as caustic soda?
A) KOH
B) NaOH
C) $Ca(OH)_2$
D) NH_4OH
Correct Answer: (B)

10. A salt is generally formed by the reaction between:
A) Two acids
B) Two bases
C) An acid and a base
D) A metal and a non-metal only
Correct Answer: (C)

11. Which reaction represents neutralization?
A) $HCl + NaOH \rightarrow NaCl + H_2O$
B) $NaOH \rightarrow Na^+ + OH^-$
C) $H_2O \rightleftharpoons H^+ + OH^-$
D) $NH_3 + H^+ \rightarrow NH_4^+$
Correct Answer: (A)

12. A salt formed in acid-base chemistry may be:
A) Only neutral
B) Only acidic
C) Only basic
D) Neutral, acidic, or basic
Correct Answer: (D)

13. Which pair correctly represents the ions formed when NaOH dissolves in water?
A) H^+ and OH^-
B) Na^+ and OH^-
C) Na^+ and Cl^-
D) H_3O^+ and Na^-
Correct Answer: (B)

14. Which pair correctly represents the ions formed when HCl ionizes in water?
A) H^+ and Cl^-
B) Na^+ and Cl^-
C) H^+ and OH^-
D) H_3O^+ and OH^-
Correct Answer: (A)

15. One limitation of the Arrhenius concept is that it is restricted mainly to:
A) Gas phase reactions
B) Aqueous solutions
C) Solid-state reactions
D) Redox reactions
Correct Answer: (B)

16. Another limitation of the Arrhenius concept is that some bases like NH_3:
A) Release H^+ in water
B) Contain OH^- in their formula

C) Are bases but do not contain OH^- in their original formula
D) Cannot react with acids
Correct Answer: (C)

17. Water is called amphoteric because it can:
A) Dissolve only acids
B) Dissolve only bases
C) Behave as both acid and base
D) Behave only as a solvent
Correct Answer: (C)

18. In the reaction $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$, water behaves as:
A) Lewis acid only
B) Bronsted acid
C) Salt
D) Neutral spectator
Correct Answer: (B)

19. In the reaction $HCl + H_2O \rightleftharpoons Cl^- + H_3O^+$, water behaves as:
A) Bronsted base
B) Bronsted acid
C) Lewis base only
D) Salt former only
Correct Answer: (A)

20. Autoionization of water produces:
A) HCl and NaOH
B) H_3O^+ and OH^-
C) H^+ and Cl^-
D) Na^+ and OH^-
Correct Answer: (B)

21. According to Bronsted-Lowry, an acid is a species that:
A) Accepts an electron pair
B) Donates a proton
C) Releases OH^- only
D) Accepts OH^-
Correct Answer: (B)

22. According to Bronsted-Lowry, a base is a species that:
A) Donates a proton
B) Releases H^+ only
C) Accepts a proton
D) Accepts a neutron
Correct Answer: (C)

23. The Bronsted-Lowry concept is broader than the Arrhenius concept because it:
A) Is limited to water
B) Includes proton transfer reactions outside aqueous solution
C) Ignores conjugate pairs
D) Applies only to strong acids
Correct Answer: (B)

24. In the reaction $HCl + NH_3 \rightarrow NH_4Cl$, HCl acts as:
A) Bronsted base
B) Bronsted acid
C) Lewis base
D) Salt
Correct Answer: (B)

25. In the reaction $HCl + NH_3 \rightarrow NH_4Cl$, NH_3 acts as:
A) Bronsted acid
B) Arrhenius acid
C) Bronsted base
D) Neutral salt
Correct Answer: (C)

26. In a Bronsted acid-base reaction, conjugate acid-base pairs differ by:
A) An electron
B) A neutron
C) A proton
D) An oxygen atom
Correct Answer: (C)

27. The species left after an acid donates a proton is called its:
A) Conjugate acid
B) Conjugate base
C) Lewis acid
D) Indicator
Correct Answer: (B)

28. The species formed when a base accepts a proton is called its:
A) Conjugate acid
B) Conjugate base
C) Salt
D) Amphoteric ion
Correct Answer: (A)

29. In the reaction $HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$, the conjugate base of HCl is:
A) H_2O
B) H_3O^+
C) Cl^-
D) OH^-
Correct Answer: (C)

30. In the reaction $HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$, the conjugate acid of H_2O is:
A) OH^-
B) H_3O^+
C) Cl^-
D) HCl
Correct Answer: (B)

31. In the reaction $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$, the conjugate acid is:
A) NH_3
B) H_2O
C) NH_4^+
D) OH^-
Correct Answer: (C)

Chapter 17: Ionic Equilibrium

101. For the reaction $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$, the correct equilibrium constant expression is:
A) $[CO][H_2]/[CH_4][H_2O]$
B) $[CO][H_2]^3/[CH_4][H_2O]$
C) $[CO]^3[H_2]/[CH_4][H_2O]$
D) $[CH_4][H_2O]/[CO][H_2]^3$
Correct Answer: (B)

102. For the reaction $2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$, the concentration term for NO_2 in the Kc expression is:
A) $[NO_2]$
B) $[NO_2]^2$
C) $[NO_2]^3$
D) $[NO_2]^4$
Correct Answer: (D)

103. In writing an equilibrium constant expression, the concentration of a species is raised to a power equal to its:
A) Atomic number
B) Valency
C) Stoichiometric coefficient in the balanced equation
D) Number of electrons
Correct Answer: (C)

104. For the general reaction $aA + bB \rightleftharpoons cC + dD$, the correct Kc expression is:
A) $[A]^a[B]^b/[C]^c[D]^d$
B) $[C]^c[D]^d/[A]^a[B]^b$
C) $[C + D]/[A + B]$
D) $[C][D]/[A][B]$
Correct Answer: (B)

105. The law of chemical equilibrium states that Kc is equal to the product of equilibrium concentrations of products divided by that of reactants, each term raised to the power of its:
A) Atomic mass
B) Charge
C) Coefficient in the balanced equation
D) Density
Correct Answer: (C)

106. In the expression Kp, the subscript p indicates that the equilibrium constant is written in terms of:
A) pH
B) Pressure of the vessel only
C) Partial pressures
D) Percentage yield
Correct Answer: (C)

107. For the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, the correct Kp expression is:
A) pNO_2/pN_2O_4
B) $(pNO_2)^2/pN_2O_4$
C) $pN_2O_4/(pNO_2)^2$
D) $(pN_2O_4)^2/pNO_2$
Correct Answer: (B)

108. The relation used to derive Kp from Kc for gaseous equilibria is:
A) $Kp = Kc/RT$
B) $Kp = Kc(RT)\Delta n$
C) $Kp = Kc + RT$
D) $Kp = Kc(RT)$
Correct Answer: (B)

109. In the relation $Kp = Kc(RT)\Delta n$, Δn is equal to:
A) Total moles of reactants + products
B) Moles of solids only
C) Sum of coefficients of gaseous products minus sum of coefficients of gaseous reactants
D) Sum of all coefficients in the equation
Correct Answer: (C)

110. For $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the value of Δn is:
A) +2
B) +1
C) −1
D) −2
Correct Answer: (D)

111. For $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the value of Δn is:
A) −2
B) −1
C) 0
D) +1
Correct Answer: (C)

112. When $\Delta n = 0$ for a gaseous equilibrium, the relation between Kp and Kc becomes:
A) $Kp = 0$
B) $Kp = 1/Kc$
C) $Kp = Kc$
D) $Kp = RT \cdot Kc$
Correct Answer: (C)

113. At 500°C, if $Kc = 6.0 \times 10^{-2}$ for $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the value of Kp is:
A) 6.0×10^{-2}
B) 1.5×10^{-5}
C) 1.5×10^{5}
D) 6.0×10^{2}
Correct Answer: (B)

114. For $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$, if $Kp = 1.9 \times 10^3$ at 25°C, the value of Kc is:
A) 4.6×10^4
B) 4.6×10^{-4}
C) 1.9×10^3

D) 2.98×10^2

Correct Answer: (A)

115. For the equilibrium $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, if $[SO_2] = 0.27$ M, $[O_2] = 0.40$ M, and $[SO_3] = 0.33$ M, Kc is:

A) 0.37
B) 3.7
C) 37
D) 0.037

Correct Answer: (B)

116. In a 5.00 L vessel at 500°C, if equilibrium amounts are $N_2 = 3.00$ mol, $H_2 = 2.10$ mol, $NH_3 = 0.298$ mol for $N_2 + 3H_2 \rightleftharpoons 2NH_3$, Kc is:

A) 0.080
B) 0.800
C) 8.00
D) 0.0080

Correct Answer: (A)

117. For $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$, if initial NOCl = 2.00 mol in 1.00 L and equilibrium [NO] = 0.66 M, then $[Cl_2]$ at equilibrium is:

A) 0.16 M
B) 0.33 M
C) 0.66 M
D) 1.34 M

Correct Answer: (B)

118. For $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$, if initial NOCl = 2.00 mol in 1.00 L and equilibrium [NO] = 0.66 M, the equilibrium concentration of NOCl is:

A) 0.66 M
B) 1.34 M
C) 1.67 M
D) 0.33 M

Correct Answer: (B)

119. For $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$, using the equilibrium data [NO] = 0.66 M, $[Cl_2] = 0.33$ M, [NOCl] = 1.34 M, the value of Kc is approximately:

A) 0.008
B) 0.080
C) 0.80
D) 8.0

Correct Answer: (B)

120. If 0.100 mol H_2 and 0.100 mol I_2 are placed in a 1 L flask and at equilibrium $[I_2]$ becomes 0.020 M for $H_2 + I_2 \rightleftharpoons 2HI$, then [HI] is:

A) 0.040 M
B) 0.080 M
C) 0.160 M
D) 0.200 M

Correct Answer: (C)

121. For $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, if 0.100 mol H_2 and 0.100 mol I_2 are placed in a 1.00 L flask and $[I_2]$ at equilibrium is 0.020 M, the equilibrium concentration of H_2 is:

A) 0.080 M
B) 0.020 M
C) 0.160 M
D) 0.100 M

Correct Answer: (B)

122. For $H_2 + I_2 \rightleftharpoons 2HI$, if $[H_2] = 0.020$ M, $[I_2] = 0.020$ M, [HI] = 0.160 M at equilibrium, Kc is:

A) 16
B) 32
C) 64
D) 128

Correct Answer: (C)

123. At 444°C, if equilibrium volumes are $H_2 = 1.35$ mL, $I_2 = 2.55$ mL, and HI = 13.5 mL for $H_2 + I_2 \rightleftharpoons 2HI$, Kc is approximately:

A) 5.294
B) 52.94
C) 529.4
D) 0.5294

Correct Answer: (B)

124. For $3C_2H_2(g) \rightleftharpoons C_6H_6(g)$, if K = 4 and $[C_2H_2]eq = 0.5$ M, then $[C_6H_6]eq$ is:

A) 0.25 M
B) 0.50 M
C) 1.00 M
D) 2.00 M

Correct Answer: (B)

125. For $CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$, if initial moles are 5, 5, 1, 1 and K = 0.137, the equilibrium concentration of CO is:

A) 0.62 M
B) 1.00 M
C) 1.62 M
D) 4.38 M

Correct Answer: (C)

126. For $CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$, if the initial moles are 5, 5, 1, and 1 and K = 0.137, the equilibrium concentration of CO_2 is:

A) 1.62 M
B) 4.38 M
C) 0.62 M
D) 5.62 M

Correct Answer: (B)

127. For $I_2(g) \rightleftharpoons 2I(g)$, if $K = 3.76 \times 10^{-5}$ at 727°C and initial $[I_2] = 0.5$ M, the equilibrium concentration of I atoms is approximately:

A) 4.34×10^{-3} M
B) 4.34×10^{-2} M
C) 2.17×10^{-3} M
D) 0.498 M

Correct Answer: (A)

Chapter 18: Atomic Structure

1. Who proposed that electrons travel in specific permitted circular orbits and no others, and that angular momentum is quantized?
A) Rutherford
B) Planck
C) de Broglie
D) Bohr
Correct Answer: (D)

2. According to the wave mechanical concept of the atom, the motion of an electron is best described by:
A) Its fixed path around the nucleus
B) Its wave properties and probabilities
C) Its electrostatic attraction to the nucleus
D) Its circular orbit as visualized by Bohr
Correct Answer: (B)

3. The de Broglie equation establishes a relationship between the momentum of a particle and its:
A) Frequency
B) Velocity
C) Wavelength
D) Energy
Correct Answer: (C)

4. According to de Broglie, the wavelength (λ) of a moving particle is given by:
A) $\lambda = h / (mv)$
B) $\lambda = mv / h$
C) $\lambda = h\ m\ v$
D) $\lambda = h\ v / m$
Correct Answer: (A)

5. The wave nature of electrons was experimentally verified by:
A) J.J. Thomson
B) Millikan
C) Davisson and Germer
D) Rutherford
Correct Answer: (C)

6. Heisenberg's uncertainty principle states that it is impossible to simultaneously know both the position and _____ of a moving particle accurately.
A) Energy
B) Mass
C) Momentum
D) Wavelength
Correct Answer: (C)

7. The mathematical expression for Heisenberg's uncertainty principle is:
A) $\Delta x \times \Delta p = h/4\pi$
B) $\Delta x \times \Delta p \geq h/4\pi$
C) $\Delta x \times \Delta p = h$
D) $\Delta x \times \Delta p = 0$
Correct Answer: (B)

8. The uncertainty principle is significant for:
A) Large objects like a moving ball
B) Microscopic particles like electrons
C) All particles, irrespective of size
D) Only stationary particles
Correct Answer: (B)

9. In Schrödinger's wave equation, the symbol ψ represents:
A) The probability of finding an electron
B) The energy of the electron
C) The amplitude of the spherical wave
D) The wavelength of the electron
Correct Answer: (C)

10. According to the interpretation of the wave function, the probability of finding an electron in a small volume around a point is proportional to:
A) ψ
B) ψ^2
C) $1/\psi$
D) ψ^{-1}
Correct Answer: (B)

11. The three-dimensional region in space where there is a high probability of finding an electron is called an:
A) Orbit
B) Orbital
C) Energy level
D) Subshell
Correct Answer: (B)

12. The principal quantum number 'n' determines the:
A) Shape of the orbital
B) Orientation of the orbital
C) Average size and energy of the electron cloud
D) Spin of the electron
Correct Answer: (C)

13. For a given principal quantum number n = 3, the possible values of the azimuthal quantum number 'l' are:
A) 0, 1, 2
B) 1, 2, 3
C) 0, 1, 2, 3
D) 1, 2
Correct Answer: (A)

14. The azimuthal quantum number 'l' defines the:
A) Size of the orbital
B) Shape of the orbital
C) Orientation of the orbital
D) Spin of the electron
Correct Answer: (B)

15. For an electron in a d-orbital, the value of the azimuthal quantum number (l) is:
A) 0
B) 1
C) 2
D) 3
Correct Answer: (C)

16. The magnetic quantum number (m) for an orbital with azimuthal quantum number l = 2 can have how many possible values?
A) 2
B) 3
C) 5
D) 7
Correct Answer: (C)

17. The magnetic quantum number accounts for the splitting of spectral lines in a magnetic field, a phenomenon known as:
A) Stark effect
B) Photoelectric effect
C) Zeeman effect
D) Compton effect
Correct Answer: (C)

18. The spin quantum number (s) of an electron can have the values:
A) 0 and 1
B) +1 and -1
C) +1/2 and -1/2
D) +1/2 and 0
Correct Answer: (C)

19. According to Pauli's exclusion principle, no two electrons in an atom can have the same set of:
A) All three quantum numbers
B) All four quantum numbers
C) Principal and azimuthal quantum numbers
D) Spin quantum numbers
Correct Answer: (B)

20. The maximum number of electrons that can be accommodated in a p-subshell is:
A) 2
B) 6
C) 10
D) 14
Correct Answer: (B)

21. According to the Aufbau principle, electrons fill orbitals in order of:
A) Decreasing energy
B) Increasing energy
C) Increasing angular momentum
D) Decreasing principal quantum number
Correct Answer: (B)

22. Hund's rule of maximum multiplicity states that electrons in a subshell are distributed so as to give the maximum number of:
A) Paired electrons
B) Unpaired electrons
C) Degenerate orbitals
D) Energy levels
Correct Answer: (B)

23. The orbital that is filled immediately after 4s according to the Aufbau principle is:
A) 3d
B) 4p
C) 5s
D) 4d
Correct Answer: (A)

24. The (n + l) rule is used to predict the:
A) Shape of an orbital
B) Orientation of an orbital
C) Order of filling of orbitals
D) Spin of an electron
Correct Answer: (C)

25. Which of the following orbitals has a lower (n + l) value, and thus lower energy, compared to 3d?
A) 4s
B) 4p
C) 3p
D) 5s
Correct Answer: (A)

26. The electron configuration of chromium (Z=24) is anomalous. The actual ground-state configuration is:
A) [Ar] $3d^4\ 4s^2$
B) [Ar] $3d^5\ 4s^1$
C) [Ar] $3d^6\ 4s^0$
D) [Ar] $3d^4\ 4s^1$
Correct Answer: (B)

27. The anomalous electron configuration of copper (Z=29) is best explained by the extra stability associated with:
A) A half-filled d-subshell
B) A completely filled d-subshell
C) A half-filled s-subshell
D) A completely filled s-subshell
Correct Answer: (B)

Chapter 19: Chemical Bonding

1. A chemical bond is the force that holds together:
A) Only atoms of metals
B) Two or more atoms or ions
C) Only ions in solution
D) Only noble gases
Correct Answer: (B)

2. Noble gases are generally least reactive because their outermost orbitals are:
A) Half-filled
B) Completely filled
C) Empty
D) Overlapping
Correct Answer: (B)

3. The tendency of atoms to attain eight electrons in the valence shell is called the:
A) Duplet rule
B) Octet rule
C) Aufbau rule
D) Pauli rule
Correct Answer: (B)

4. The noble gas configuration of helium is represented by:
A) ns^2np^6
B) $1s^2$
C) $1s^1$
D) $2s^22p^6$
Correct Answer: (B)

5. The noble gas configuration of neon is represented by:
A) $1s^22s^22p^6$
B) $1s^22s^22p^4$
C) $1s^22s^2$
D) $2s^22p^6$
Correct Answer: (A)

6. In NaH, hydrogen stabilizes itself mainly by:
A) Losing one electron
B) Gaining one electron
C) Sharing two electrons equally
D) Forming a metallic bond
Correct Answer: (B)

7. In HF, the shared electron pair is attracted more strongly by:
A) Hydrogen
B) Fluorine
C) Both equally
D) Sodium
Correct Answer: (B)

8. Which compound is a common exception to the octet rule because of an incomplete octet?
A) CH_4
B) NH_3
C) BCl_3
D) H_2O
Correct Answer: (C)

9. Which compound is a common exception to the octet rule because of an expanded octet?
A) NH_3
B) CH_4
C) PF_5
D) HCl
Correct Answer: (C)

10. According to modern bonding theory, atoms form bonds because bonding leads to:
A) Increase in energy
B) Decrease in energy
C) No change in energy
D) Infinite energy
Correct Answer: (B)

11. During approach of two hydrogen atoms, attractive forces tend to:
A) Increase potential energy
B) Push atoms apart
C) Decrease potential energy
D) Destroy the nuclei
Correct Answer: (C)

12. During approach of two hydrogen atoms, repulsive forces tend to:
A) Lower potential energy
B) Push atoms apart
C) Produce a permanent bond immediately
D) Create ions only
Correct Answer: (B)

13. A stable bond forms when:
A) Repulsive forces dominate attractive forces
B) Attractive forces dominate repulsive forces at equilibrium distance
C) Only nuclear repulsion remains
D) Potential energy becomes maximum
Correct Answer: (B)

14. The bond length in H_2 is approximately:
A) 54.7 pm
B) 65.4 pm
C) 75.4 pm
D) 95.4 pm
Correct Answer: (C)

15. The bond formation energy of H_2 is approximately:
A) 236.45 kJ mol^{-1}
B) 336.45 kJ mol^{-1}
C) 436.45 kJ mol^{-1}
D) 536.45 kJ mol^{-1}
Correct Answer: (C)

16. The same amount of energy required to break H_2 as released on its formation is its:
A) Lattice energy
B) Bond energy
C) Electron affinity
D) Ionization energy
Correct Answer: (B)

17. If repulsive forces become greater than attractive forces, the system becomes:
A) More stable
B) Ionic
C) Unstable
D) Paramagnetic
Correct Answer: (C)

18. Atomic size is commonly expressed in terms of:
A) Density only
B) Atomic radii
C) Heat capacity
D) Lattice energy
Correct Answer: (B)

19. The radius measured for an ion in an ionic crystal is called:
A) Atomic radius
B) Covalent radius
C) Ionic radius
D) Metallic radius
Correct Answer: (C)

20. The radius measured from covalently bonded atoms is called:
A) Ionic radius
B) Covalent radius
C) Nuclear radius
D) Effective radius
Correct Answer: (B)

21. Across a period, atomic size generally:
A) Increases
B) Remains constant
C) Decreases
D) Becomes zero
Correct Answer: (C)

22. Down a group, atomic size generally:
A) Decreases
B) Increases
C) Remains constant
D) Becomes negligible
Correct Answer: (B)

23. The minimum energy required to remove an electron from a gaseous atom is called:
A) Electron affinity
B) Bond energy
C) Ionization energy
D) Hydration energy
Correct Answer: (C)

24. Ionization energy generally increases across a period because:
A) Atomic size increases
B) Effective nuclear attraction increases
C) Shielding becomes zero
D) Orbitals disappear
Correct Answer: (B)

25. Ionization energy generally decreases down a group because:
A) Atomic size and shielding increase
B) Nuclear charge becomes zero
C) Valence electrons vanish
D) Covalent radius decreases
Correct Answer: (A)

26. Electron affinity is the energy change when an electron is added to:
A) A nucleus
B) A gaseous atom
C) A cation only
D) A molecule only
Correct Answer: (B)

27. A large negative electron affinity value indicates that an atom:
A) Strongly resists electron gain
B) Easily gains an electron
C) Loses electrons readily
D) Behaves as a noble gas
Correct Answer: (B)

28. Electronegativity is the tendency of an atom to attract:
A) Its nucleus
B) Shared electron pair
C) Free neutrons
D) Protons from another atom
Correct Answer: (B)

29. The most electronegative element on Pauling scale is:
A) Oxygen
B) Nitrogen
C) Chlorine
D) Fluorine
Correct Answer: (D)

30. Electronegativity has:
A) Unit of joule
B) Unit of volt
C) No unit
D) Unit of coulomb
Correct Answer: (C)

31. Electronegativity generally increases across a period due to:
A) Increase in atomic size
B) Decrease in nuclear attraction
C) Decrease in atomic size
D) Increase in metallic character
Correct Answer: (C)

32. Electronegativity generally decreases down a group because:
A) Atomic size increases
B) Nuclear charge disappears
C) Electrons are lost completely
D) Period number decreases
Correct Answer: (A)

33. The bond between similar atoms is generally:
A) Ionic
B) Metallic
C) Non-polar covalent

Chapter 20: Chemical Kinetic

1. The branch of chemistry that deals with reaction rates is called:
A) Thermodynamics
B) Electrochemistry
C) Chemical kinetics
D) Analytical chemistry
Correct Answer: (C)

2. In equilibrium reactions, the rate of forward reaction is:
A) Greater than backward
B) Less than backward
C) Equal to backward
D) Zero
Correct Answer: (C)

3. A spontaneous reaction proceeds:
A) From right to left
B) From left to right
C) In both directions equally
D) Only at equilibrium
Correct Answer: (B)

4. Rusting of iron is an example of:
A) Fast reaction
B) Instantaneous reaction
C) Slow reaction
D) Reversible reaction
Correct Answer: (C)

5. Reaction rate is defined as:
A) Change in temperature
B) Change in pressure
C) Change in concentration per unit time
D) Total energy change
Correct Answer: (C)

6. The rate of disappearance of a reactant is represented by:
A) Positive sign
B) Negative sign
C) Zero
D) Constant value
Correct Answer: (B)

7. Units of reaction rate are:
A) mol
B) mol^{-1}
C) $mol\ L^{-1}\ s^{-1}$
D) s^{-1}
Correct Answer: (C)

8. Instantaneous rate is obtained when:
A) Δt is large
B) Δt approaches zero
C) Δt is constant
D) Δt is infinite
Correct Answer: (B)

9. Instantaneous rate corresponds to:
A) Area under curve
B) Average slope
C) Slope of tangent
D) Intercept
Correct Answer: (C)

10. Rate law expresses relation between:
A) Temperature and pressure
B) Rate and concentration
C) Volume and pressure
D) Energy and time
Correct Answer: (B)

11. General rate law is:
A) rate = k
B) rate = k[A]
C) rate = $k[A]^n$
D) rate = [A]/k
Correct Answer: (C)

12. Rate constant is:
A) Variable
B) Independent of concentration
C) Depends on time
D) Zero
Correct Answer: (B)

13. Order of reaction is:
A) Product of powers
B) Difference of powers
C) Sum of powers
D) Square of powers
Correct Answer: (C)

14. If rate = $k[A]^2[B]$, order is:
A) 2
B) 3
C) 1
D) 4
Correct Answer: (B)

15. Zero order reaction rate depends on:
A) Concentration
B) Temperature only
C) Independent of concentration
D) Pressure only
Correct Answer: (C)

16. In zero order reaction:
A) Rate increases with concentration
B) Rate decreases with concentration
C) Rate remains constant
D) Rate becomes zero
Correct Answer: (C)

17. Molecularity refers to:
A) Number of steps
B) Number of molecules colliding
C) Rate constant
D) Order
Correct Answer: (B)

18. Molecularity is defined for:
A) Complex reactions
B) Elementary reactions
C) All reactions
D) Equilibrium reactions
Correct Answer: (B)

19. Unimolecular reaction involves:
A) 1 molecule
B) 2 molecules
C) 3 molecules
D) Many molecules
Correct Answer: (A)

20. Bimolecular reaction involves:
A) One molecule
B) Two molecules
C) Three molecules
D) Four molecules
Correct Answer: (B)

21. Termolecular reaction involves:
A) 1 molecule
B) 2 molecules
C) 3 molecules
D) 4 molecules
Correct Answer: (C)

22. High molecularity reactions are rare because:
A) Energy is low
B) Collision probability is low
C) Temperature is low
D) Pressure is low
Correct Answer: (B)

23. Slowest step in mechanism is:
A) Fast step
B) Rate determining step
C) Initial step
D) Final step
Correct Answer: (B)

24. Order may be:
A) Always integer
B) Fractional
C) Always zero
D) Always positive integer
Correct Answer: (B)

25. Molecularity is always:
A) Fractional
B) Whole number
C) Negative
D) Zero
Correct Answer: (B)

26. Molecularity can never be:
A) 1
B) 2
C) 3
D) 0
Correct Answer: (D)

27. Pseudo-first order reaction occurs when:
A) One reactant in excess
B) All reactants equal
C) No reactant present
D) Temperature is high
Correct Answer: (A)

28. Hydrolysis of ester is example of:
A) Zero order
B) First order
C) Pseudo-first order
D) Third order
Correct Answer: (C)

29. Integrated rate law for zero order:
A) $x = kt$
B) $\ln a/x = kt$
C) $1/[A] = kt$
D) $k = 0$
Correct Answer: (A)

30. Unit of zero order rate constant:
A) s^{-1}
B) mol L^{-1} s^{-1}
C) L mol^{-1} s^{-1}
D) mol^{-2}
Correct Answer: (B)

31. First order integrated equation:
A) $x = kt$
B) $\ln(a/(a - x)) = kt$
C) $1/[A] = kt$
D) rate = k
Correct Answer: (B)

32. Unit of first order rate constant:
A) mol L^{-1} s^{-1}
B) s^{-1}
C) L mol^{-1} s^{-1}
D) mol^{2}
Correct Answer: (B)

33. Half-life of first order reaction depends on:
A) Initial concentration
B) Rate constant only
C) Temperature only
D) Pressure
Correct Answer: (B)

34. Half-life formula for a first-order reaction is:
A) $t_{1/2} = k$
B) $t_{1/2} = \ln 2/k$
C) $t_{1/2} = k/\ln 2$
D) $t_{1/2} = 2k$
Correct Answer: (B)

Chapter 21: Thermochemistry

1. What is the primary reason for energy changes in chemical reactions?
A) Changes in temperature of the surroundings
B) The breaking of bonds in reactants and formation of new bonds in products
C) The change in physical state of the reactants
D) The pressure-volume work done by the system
Correct Answer: (B)

2. In an exothermic process, the total energy of the products is:
A) Greater than the total energy of the reactants
B) Less than the total energy of the reactants
C) Equal to the total energy of the reactants
D) Unrelated to the total energy of the reactants
Correct Answer: (B)

3. Which of the following is NOT a state function?
A) Enthalpy
B) Internal energy
C) Heat
D) Pressure
Correct Answer: (C)

4. Which of the following processes is classified as endothermic?
A) Combustion of methane
B) Neutralization of HCl and NaOH
C) Dissolution of NaOH in water
D) Melting of ice
Correct Answer: (D)

5. The internal energy of a system is the sum of:
A) Only the kinetic energies of its particles
B) Only the potential energies of its particles
C) The kinetic and potential energies of all its particles
D) The heat and work exchanged with the surroundings
Correct Answer: (C)

6. The change in internal energy (ΔE) for a reaction carried out at constant volume is equal to:
A) ΔH
B) q_p
C) q_v
D) w
Correct Answer: (C)

7. What is the standard enthalpy of formation (ΔHf°) of an element in its most stable form?
A) 1 kJ mol^{-1}
B) 1 cal mol^{-1}
C) Zero
D) A positive value
Correct Answer: (C)

8. The standard enthalpy of formation of $CO_2(g)$ is -393.51 kJ mol^{-1}. This means that:
A) 393.51 kJ of heat is absorbed when 1 mole of CO_2 is formed from its elements
B) 393.51 kJ of heat is released when 1 mole of CO_2 is formed from its elements
C) 393.51 kJ of heat is released when 1 mole of CO_2 decomposes into its elements
D) The reaction is endothermic
Correct Answer: (B)

9. According to Hess's law, the net heat change in a chemical reaction depends on:
A) The number of intermediate steps
B) The path adopted for the reaction
C) The initial and final states only
D) The rate of the reaction
Correct Answer: (C)

10. The enthalpy of neutralization for a strong acid and a strong base is approximately constant because:
A) The acid and base always react in a 1:1 mole ratio
B) The net chemical change is the combination of H^+ and OH^- ions to form water
C) The salts formed are always soluble
D) The reaction is always exothermic
Correct Answer: (B)

11. In the expression ΔH = ΔE + ΔnRT, 'Δn' represents:
A) Change in number of moles of all reactants and products
B) Change in number of moles of gaseous species only
C) Change in number of moles of solids and liquids only
D) Change in number of moles of electrons transferred
Correct Answer: (B)

12. Using the chemistry sign convention, the work done during expansion against a constant external pressure, P_{ext}, is given by:
A) w = PextΔV
B) w = -PextΔV
C) w = -ΔnRT
D) w = ΔE - q
Correct Answer: (B)

13. For a gaseous reaction where the number of moles of products is greater than the number of moles of reactants, the relationship between ΔH and ΔE is:
A) ΔH = ΔE
B) ΔH < ΔE
C) ΔH > ΔE
D) ΔH = 0
Correct Answer: (C)

14. Which of the following is an example of a pressure-volume work?
A) Electrical work done by a battery
B) Work done by a gas expanding against a piston
C) Work done in lifting a weight
D) Work done in stretching a spring
Correct Answer: (B)

15. The standard enthalpy of combustion (ΔHc°) is defined as the heat produced when:
A) One mole of a compound is formed from its elements
B) One mole of a compound is completely burnt in excess of oxygen
C) One gram of a substance is completely burnt
D) A substance reacts with oxygen to form an oxide
Correct Answer: (B)

16. A process that takes place on its own without any outside assistance is called:
A) Non-spontaneous
B) Reversible
C) Spontaneous
D) Adiabatic
Correct Answer: (C)

17. The first law of thermodynamics is essentially a statement of:
A) The law of conservation of mass
B) The law of conservation of energy
C) The law of entropy
D) The law of equipartition of energy
Correct Answer: (B)

18. For a cyclic process, the change in internal energy (ΔE) is:
A) Positive
B) Negative
C) Zero
D) Dependent on the path
Correct Answer: (C)

19. An isolated system is one that can exchange:
A) Neither matter nor energy with its surroundings
B) Only matter with its surroundings
C) Only energy with its surroundings
D) Both matter and energy with its surroundings
Correct Answer: (A)

20. In a bomb calorimeter, the heat measured (q_v) is directly equal to:
A) ΔH
B) ΔE
C) ΔS
D) ΔG
Correct Answer: (B)

21. The molar heat capacity at constant volume (C_v,m) for a monatomic ideal gas is:
A) (3/2)R
B) (5/2)R
C) R
D) (7/2)R
Correct Answer: (A)

22. The enthalpy change (ΔH) for the reaction C(s) + O_2(g) → CO_2(g) is equal to:
A) The standard enthalpy of formation of CO_2
B) The standard enthalpy of combustion of C
C) Both (A) and (B)
D) The standard enthalpy of atomization of C
Correct Answer: (C)

23. In the Joule-Thomson experiment, the expansion of a gas occurs at constant:
A) Temperature
B) Pressure
C) Volume
D) Enthalpy
Correct Answer: (D)

24. A positive value of the Joule-Thomson coefficient (μ) indicates that the gas:
A) Heats up upon expansion
B) Cools down upon expansion
C) Behaves ideally
D) Undergoes a phase change
Correct Answer: (B)

Chapter 23: Electrochemistry

1. **In a free elemental state, the oxidation number of an atom is:**
A) always 0
B) equal to its atomic number
C) always +1
D) always −1
Correct Answer: (A)

2. **The oxidation number of a monoatomic ion is equal to:**
A) its mass number
B) its valency only
C) its ionic charge
D) the charge on the opposite ion
Correct Answer: (C)

3. **The oxidation number of hydrogen in most of its compounds is:**
A) 0
B) +1
C) −1
D) +2
Correct Answer: (B)

4. **In metal hydrides, hydrogen usually has oxidation number:**
A) +1
B) 0
C) −1
D) −2
Correct Answer: (C)

5. **The usual oxidation number of oxygen in most compounds is:**
A) +2
B) −2
C) −1
D) 0
Correct Answer: (B)

6. **The oxidation number of oxygen in peroxides is:**
A) −2
B) −1
C) +1
D) +2
Correct Answer: (B)

7. **The oxidation number of oxygen in OF_2 is:**
A) −2
B) −1
C) +1
D) +2
Correct Answer: (D)

8. **The oxidation number of oxygen in a superoxide is:**
A) −1/2
B) −1
C) −2
D) +1
Correct Answer: (A)

9. **In a neutral molecule, the algebraic sum of oxidation numbers of all atoms is:**
A) always +1
B) always 0
C) equal to valency of the central atom
D) equal to the number of atoms
Correct Answer: (B)

10. **In a polyatomic ion, the algebraic sum of oxidation numbers of all atoms is equal to:**
A) 0
B) the ionic charge
C) the atomic number of the central atom
D) the number of electrons lost
Correct Answer: (B)

11. **In a compound, the more electronegative atom is generally assigned:**
A) a positive oxidation number
B) zero oxidation number
C) a negative oxidation number
D) a fractional oxidation number only
Correct Answer: (C)

12. **Oxidation in terms of electrons is best defined as:**
A) gain of electrons
B) loss of electrons
C) gain of oxygen only
D) loss of hydrogen only
Correct Answer: (B)

13. **Reduction in terms of electrons is best defined as:**
A) gain of electrons
B) loss of electrons
C) gain of oxygen
D) increase in oxidation number
Correct Answer: (A)

14. **Oxidation in terms of oxidation number involves:**
A) a decrease in oxidation number
B) an increase in oxidation number
C) no change in oxidation number
D) complete neutralization
Correct Answer: (B)

15. **Reduction in terms of oxidation number involves:**
A) an increase in oxidation number
B) no change in oxidation number
C) a decrease in oxidation number
D) loss of oxygen only
Correct Answer: (C)

16. **A reaction in which oxidation and reduction occur simultaneously is called:**
A) a neutralization reaction
B) an addition reaction
C) a redox reaction
D) a double decomposition reaction
Correct Answer: (C)
17. **In the reaction $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$, the species oxidized is:**
A) Cu
B) Cu^{2+}
C) Zn
D) Zn^{2+}
Correct Answer: (C)
18. **In the reaction $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$, the species reduced is:**
A) Zn
B) Zn^{2+}
C) Cu
D) Cu^{2+}
Correct Answer: (D)
19. **In the reaction $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$, the oxidizing agent is:**
A) Zn
B) Zn^{2+}
C) Cu^{2+}
D) Cu
Correct Answer: (C)
20. **In the reaction $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$, the reducing agent is:**
A) Cu
B) Cu^{2+}
C) Zn^{2+}
D) Zn
Correct Answer: (D)
21. **In the reaction $2Na + Cl_2 \rightarrow 2NaCl$, sodium undergoes:**
A) reduction
B) oxidation
C) disproportionation
D) neither oxidation nor reduction
Correct Answer: (B)
22. **In the reaction $2Na + Cl_2 \rightarrow 2NaCl$, chlorine undergoes:**
A) oxidation
B) reduction
C) displacement only
D) hydrolysis
Correct Answer: (B)
23. **The oxidation number of Mn in $KMnO_4$ is:**
A) +4
B) +5
C) +6
D) +7
Correct Answer: (D)
24. **The oxidation number of S in SO_4^{2-} is:**
A) +4
B) +6
C) −2
D) +2
Correct Answer: (B)
25. **The oxidation number of Cr in $CrCl_3$ is:**
A) +2
B) +3
C) +4
D) +6
Correct Answer: (B)
26. **The oxidation number of Cr in K_2CrO_4 is:**
A) +2
B) +3
C) +4
D) +6
Correct Answer: (D)
27. **The oxidation number of Cr in $K_2Cr_2O_7$ is:**
A) +2
B) +3
C) +6
D) +7
Correct Answer: (C)
28. **The oxidation number of Cr in CrO_3 is:**
A) +3
B) +4
C) +5
D) +6
Correct Answer: (D)
29. **The oxidation number of Cr in Cr_2O_3 is:**
A) +2
B) +3
C) +4
D) +6
Correct Answer: (B)
30. **The oxidation number of chlorine in $Ca(ClO_3)_2$ is:**
A) +1
B) +3
C) +5
D) +7
Correct Answer: (C)
31. **The oxidation number of carbon in Na_2CO_3 is:**
A) +2
B) +4
C) +6
D) −4
Correct Answer: (B)
32. **The oxidation number of nitrogen in HNO_3 is:**
A) +3
B) +4

Chapter 24: Organic Reactions

1. Which mechanism is favored for the reaction of tert-butyl chloride with H_2O?
A) SN2
B) SN1
C) E2
D) Radical substitution
Correct Answer: (B)

2. The rate of SN2 reaction depends on:
A) Only substrate concentration
B) Only nucleophile concentration
C) Both substrate and nucleophile concentration
D) Solvent polarity only
Correct Answer: (C)

3. Which substrate undergoes SN2 fastest?
A) $(CH_3)_3CCl$
B) CH_3CH_2Cl
C) $(CH_3)_2CHCl$
D) C_6H_5Cl
Correct Answer: (B)

4. The stereochemical outcome of SN2 reaction is:
A) Retention
B) Racemization
C) Inversion
D) No change
Correct Answer: (C)

5. Which intermediate is formed in SN1 reaction?
A) Carbanion
B) Carbocation
C) Radical
D) Carbenium ion pair only
Correct Answer: (B)

6. Order of carbocation stability is:
A) 1° > 2° > 3°
B) 3° > 2° > 1°
C) 2° > 3° > 1°
D) 1° > 3° > 2°
Correct Answer: (B)

7. Which effect stabilizes carbocation most?
A) Inductive withdrawal
B) Hyperconjugation
C) Hydrogen bonding
D) Steric hindrance
Correct Answer: (B)

8. In E2 mechanism, elimination occurs via:
A) Two-step process
B) One-step process
C) Radical pathway
D) Carbocation formation
Correct Answer: (B)

9. Strong base favors:
A) SN1
B) SN2
C) E2
D) Rearrangement
Correct Answer: (C)

10. Which condition favors E1 reaction?
A) Strong nucleophile
B) Weak base
C) Low temperature
D) Non-polar solvent
Correct Answer: (B)

11. Major product of dehydration of ethanol with conc. H_2SO_4 at 170°C is:
A) Ethanol
B) Ethene
C) Ether
D) Acetaldehyde
Correct Answer: (B)

12. Markovnikov addition of HBr to propene gives:
A) 1-bromopropane
B) 2-bromopropane
C) Propanol
D) Propane
Correct Answer: (B)

13. Anti-Markovnikov addition occurs in presence of:
A) H_2SO_4
B) ROOR
C) NaOH
D) HCl
Correct Answer: (B)

14. Which reaction proceeds via radical mechanism?
A) SN1
B) SN2
C) Peroxide effect
D) E1
Correct Answer: (C)

15. Hybridization of carbocation carbon is:
A) sp^3
B) sp^2
C) sp
D) dsp^2
Correct Answer: (B)

16. Geometry of carbocation is:
A) Tetrahedral
B) Linear
C) Trigonal planar
D) Bent
Correct Answer: (C)

17. Which reagent converts alcohol to alkyl chloride?
A) NaOH

B) PCl_5
C) $KMnO_4$
D) H_2O
Correct Answer: (B)
18. SN1 reaction rate-determining step is:
A) Nucleophilic attack
B) Carbocation formation
C) Proton transfer
D) Rearrangement
Correct Answer: (B)
19. Which solvent favors SN1?
A) Non-polar
B) Polar protic
C) Polar aprotic
D) Gas phase
Correct Answer: (B)
20. Which solvent favors SN2?
A) Polar protic
B) Non-polar
C) Polar aprotic
D) Acidic
Correct Answer: (C)
21. Which nucleophile is strongest?
A) H_2O
B) OH^-
C) ROH
D) NH_3
Correct Answer: (B)
22. Leaving group ability increases with:
A) Basicity
B) Stability
C) Electronegativity decrease
D) Size decrease
Correct Answer: (B)
23. Best leaving group among these is:
A) OH^-
B) Cl^-
C) NH_2^-
D) CH_3^-
Correct Answer: (B)
24. Which reaction gives racemization?
A) SN2
B) SN1
C) E2
D) Addition
Correct Answer: (B)
25. Rearrangement occurs in:
A) SN2
B) SN1
C) E2
D) Radical addition
Correct Answer: (B)
26. Hydride shift leads to formation of:
A) Less stable carbocation
B) More stable carbocation
C) Radical
D) Alkene
Correct Answer: (B)
27. Which is aromatic?
A) Cyclobutadiene
B) Benzene
C) Cyclooctatetraene
D) Propene
Correct Answer: (B)
28. Hückel rule is:
A) 2n π electrons
B) 4n π electrons
C) (4n+2) π electrons
D) n^2 electrons
Correct Answer: (C)
29. Benzene undergoes:
A) Addition
B) Substitution
C) Elimination
D) Rearrangement
Correct Answer: (B)
30. Electrophile in nitration of benzene is:
A) NO_2^-
B) NO_2^+
C) NO
D) N_2O_4
Correct Answer: (B)
31. Catalyst in Friedel-Crafts alkylation is:
A) H_2SO_4
B) $AlCl_3$
C) NaOH
D) $KMnO_4$
Correct Answer: (B)
32. Which group is activating in benzene?
A) $-NO_2$
B) –Cl
C) –OH
D) –COOH
Correct Answer: (C)
33. Which is deactivating?
A) $-CH_3$
B) –OH
C) $-NO_2$
D) $-NH_2$
Correct Answer: (C)
34. Ortho-para director is:
A) $-NO_2$
B) –COOH
C) $-CH_3$
D) –CN
Correct Answer: (C)
35. Meta director is:
A) –OH

Chapter 25: Alkanes

1. Which of the following statements best explains why alkanes are considered saturated hydrocarbons?
A) They contain only carbon and hydrogen atoms.
B) They have the general formula C_nH_{2n}.
C) They contain only C–C and C–H single bonds, thus possessing the maximum number of hydrogens per carbon.
D) They are highly reactive with halogens.
Correct Answer: (C)

2. A functional group is best described as:
A) A group of atoms that gives a molecule its specific physical properties.
B) A group of atoms within a molecule that has a characteristic chemical reactivity.
C) The longest continuous carbon chain in a molecule.
D) Any atom other than carbon and hydrogen in an organic molecule.
Correct Answer: (B)

3. Considering the reaction of ethylene and menthene with bromine, the key observation is that:
A) Only ethylene reacts due to its smaller size.
B) The reactions yield different products due to different functional groups.
C) Both react in the same way because they contain the same carbon-carbon double bond functional group.
D) Menthene does not react because the double bond is sterically hindered.
Correct Answer: (C)

4. Which of the following functional groups contains a carbon atom singly bonded to an electronegative atom, resulting in a polar bond with a partial positive charge on the carbon?
A) Alkene
B) Aldehyde
C) Alcohol
D) Alkyne
Correct Answer: (C)

5. A key structural difference between an aldehyde and a ketone is that:
A) Aldehydes contain a carbonyl group, while ketones do not.
B) Ketones have at least one hydrogen atom bonded to the carbonyl carbon, while aldehydes have two carbons bonded to it.
C) Aldehydes have at least one hydrogen atom bonded to the carbonyl carbon, while ketones have two carbons bonded to it.
D) Ketones are more polar than aldehydes.
Correct Answer: (C)

6. In a carbonyl group, the partial charges are best described as:
A) Carbon bears a partial negative charge (δ-), and oxygen bears a partial positive charge (δ+).
B) Both atoms bear a partial negative charge.
C) Both atoms bear a partial positive charge.
D) Carbon bears a partial positive charge (δ+), and oxygen bears a partial negative charge (δ-).
Correct Answer: (D)

7. The general formula for a non-cyclic alkane is C_nH_{2n+2}. What is the molecular formula for the alkane containing 12 carbon atoms?
A) $C_{12}H_{24}$
B) $C_{12}H_{26}$
C) $C_{12}H_{28}$
D) $C_{12}H_{22}$
Correct Answer: (B)

8. Which of the following pairs are constitutional isomers?
A) Ethane and propane
B) Butane and 2-methylpropane
C) Cyclohexane and hexane
D) Methane and ethane
Correct Answer: (B)

9. How many constitutional isomers exist for the molecular formula C_5H_{12}?
A) 2
B) 3
C) 4
D) 5
Correct Answer: (B)

10. A compound with the molecular formula $C_4H_{10}O$ is analyzed. It is found to be an ether. Which of the following structures is a valid constitutional isomer for this compound?
A) $CH_3CH_2CH_2CH_2OH$
B) $CH_3CH_2OCH_2CH_3$
C) $CH_3CH_2CH_2OCH_3$
D) Both B and C
Correct Answer: (D)

11. Removing a hydrogen atom from methane (CH_4) yields a methyl group. This group, when attached to a parent chain, is named as a substituent. What is the correct name for the group $-CH_2CH_3$?
A) Methyl
B) Propyl
C) Ethyl
D) Butyl
Correct Answer: (C)

12. A carbon atom that is bonded to three other carbon atoms is classified as:
A) Primary
B) Secondary
C) Tertiary
D) Quaternary
Correct Answer: (C)

13. In the molecule 2-methylpropane ($(CH_3)_3CH$), the central carbon atom is:

A) Primary
B) Secondary
C) Tertiary
D) Quaternary
Correct Answer: (C)

14. Which of the following statements about a quaternary carbon atom is correct?
A) It is bonded to four hydrogen atoms.
B) It is bonded to four other carbon atoms.
C) It is bonded to one other carbon atom and three hydrogens.
D) It is a carbon atom that is part of a double bond.
Correct Answer: (B)

15. According to IUPAC nomenclature, the first step in naming a branched-chain alkane is to:
A) Number the carbon atoms in the parent chain.
B) Identify and name the substituents.
C) Find the longest continuous chain of carbon atoms to serve as the parent.
D) Arrange the substituents in alphabetical order.
Correct Answer: (C)

16. What is the correct IUPAC name for the compound $(CH_3)_2CHCH_2CH_3$?
A) 1-Methylbutane
B) 2-Methylbutane
C) 3-Methylbutane
D) Isopentane
Correct Answer: (B)

17. When numbering the parent chain for an alkane with multiple substituents, the numbering should be chosen to:
A) Give the parent chain the most number of carbons.
B) Give the first substituent encountered the lowest possible number.
C) Give the last substituent encountered the highest possible number.
D) Alphabetize the substituents before numbering.
Correct Answer: (B)

18. What is the correct IUPAC name for the following compound?
$CH_3CH_2CH(CH_3)CH_2CH_2CH_3$
A) 2-Ethylpentane
B) 3-Methylhexane
C) 4-Methylhexane
D) Heptane
Correct Answer: (B)

19. A compound is named 3-ethyl-2-methylpentane. Which of the following is a correct representation of its structure?
A) $CH_3CH_2CH(CH_3)CH(C_2H_5)CH_3$
B) $CH_3CH_2CH_2C(CH_3)(C_2H_5)CH_3$
C) $CH_3CH_2CH(C_2H_5)CH(CH_3)CH_3$
D) $CH_3CH(CH_3)CH(C_2H_5)CH_2CH_3$
Correct Answer: (D)

20. When alphabetizing substituents for an IUPAC name, the prefixes "sec-" and "tert-" are:
A) Considered for alphabetization.
B) Ignored for alphabetization, but "iso-" is considered.
C) Considered as part of the main alkyl group name.
D) Written in italics and hyphenated, and are not considered for alphabetization.
Correct Answer: (B)

21. What is the correct IUPAC name for the compound commonly known as isooctane, 2,2,4-trimethylpentane?
A) A straight-chain octane isomer.
B) 2,2,4-Trimethylpentane
C) 2,4,4-Trimethylpentane
D) 2,2,4-Trimethylheptane
Correct Answer: (B)

22. Which of the following is the correct structure for 4-isopropylheptane?
A) $CH_3CH_2CH_2CH(CH(CH_3)_2)CH_2CH_2CH_3$
B) $CH_3CH(CH_3)CH_2CH_2CH(CH_3)CH_3$
C) $CH_3CH_2CH_2C(CH_3)(C_3H_7)CH_3$
D) $CH_3CH_2CH_2CH_2CH_2CH(CH_3)CH_3$
Correct Answer: (A)

23. Alkanes are relatively inert because:
A) They are saturated hydrocarbons with strong C–C and C–H bonds and are nonpolar.
B) They can easily form hydrogen bonds with water.
C) They have high boiling points, making reactions difficult.
D) They are readily oxidized at room temperature.
Correct Answer: (A)

24. The combustion of alkanes is an example of:
A) A substitution reaction.
B) An addition reaction.
C) An oxidation reaction that releases a large amount of heat.
D) A reduction reaction.
Correct Answer: (C)

25. The reaction of methane with chlorine (Cl_2) in the presence of ultraviolet light (hv) primarily yields:
A) Only CH_3Cl and HCl.
B) A mixture of chlorinated products including CH_3Cl, CH_2Cl_2, $CHCl_3$, and CCl_4.
C) Only CCl_4 and HCl.
D) Ethane and HCl.
Correct Answer: (B)

26. For a series of straight-chain alkanes, as the molecular weight increases, the boiling point:
A) Decreases regularly.
B) Increases regularly.
C) Remains constant.
D) Increases, then decreases.
Correct Answer: (B)

27. Which of the following alkanes would be expected to have the highest boiling point?
A) Pentane

Chapter 26: Alkenes, Alkynes

1. The general molecular formula of an acyclic alkene containing one C=C bond is:
A) C_nH_{2n+2}
B) C_nH_{2n}
C) C_nH_{2n-2}
D) $C_nH_{2n+1}X$
Correct Answer: B) C_nH_{2n}

2. The degree of unsaturation of C_6H_{10} is:
A) 1
B) 2
C) 3
D) 4
Correct Answer: B) 2

3. A compound with formula $C_4H_6Br_2$ has a degree of unsaturation equal to:
A) 0
B) 1
C) 2
D) 3
Correct Answer: B) 1

4. Ethyne differs from ethene mainly because ethyne contains:
A) One π bond only
B) One σ and one π bond
C) One σ and two π bonds
D) Two σ and one π bond
Correct Answer: C) One σ and two π bonds

5. The carbon atoms of a C=C bond in an alkene are usually:
A) sp^3 hybridized
B) sp^2 hybridized
C) sp hybridized
D) dsp^2 hybridized
Correct Answer: B) sp^2 hybridized

6. The geometry around each doubly bonded carbon in ethene is approximately:
A) Linear
B) Tetrahedral
C) Trigonal planar
D) Trigonal pyramidal
Correct Answer: C) Trigonal planar

7. The old common name for alkenes is:
A) Paraffins
B) Olefins
C) Acetylenes
D) Arenes
Correct Answer: B) Olefins

8. The common name for the family containing C≡C is:
A) Olefins
B) Paraffins
C) Acetylenes
D) Cycloalkanes
Correct Answer: C) Acetylenes

9. A hydrocarbon containing a carbon–carbon triple bond is called a(n):
A) Alkane
B) Alkene
C) Arene
D) Alkyne
Correct Answer: D) Alkyne

10. The suffix used in IUPAC naming of alkynes is:
A) -ane
B) -ene
C) -yne
D) -yl
Correct Answer: C) -yne

11. In naming an alkyne, numbering starts from the end nearest the:
A) First substituent
B) Triple bond
C) Longest branch
D) Most electronegative atom
Correct Answer: B) Triple bond

12. The correct name for $HC{\equiv}CCH_2CH_2CH_2CH{=}CH_2$ is:
A) 6-Hepten-1-yne
B) 1-Hepten-6-yne
C) Hept-6-en-1-yne
D) Hept-1-yne-6-ene
Correct Answer: C) Hept-6-en-1-yne

13. When both double and triple bonds are present in a chain, preference in numbering is given to the:
A) Triple bond
B) Double bond
C) Longer substituent
D) Branched end
Correct Answer: B) Double bond

14. The group $CH_3CH_2C{\equiv}C–$ is called:
A) Butyl
B) But-1-enyl
C) But-1-yn-1-yl
D) Vinyl
Correct Answer: C) But-1-yn-1-yl

15. Alkenes and alkynes up to about four carbons are generally:
A) Solids
B) Liquids
C) Gases
D) Ionic solids
Correct Answer: C) Gases

16. Compared with water, the densities of most alkenes and alkynes are:
A) Higher
B) Much higher
C) Equal
D) Lower
Correct Answer: D) Lower
17. Bromine decolorization at room temperature in the dark is a positive test for:
A) Alkanes only
B) Alcohols only
C) Alkenes and alkynes
D) Aromatic compounds only
Correct Answer: C) Alkenes and alkynes
18. Alkanes generally do not rapidly decolorize Br_2 in the dark because they undergo:
A) Fast addition
B) No appreciable reaction under those conditions
C) Ionic substitution instantly
D) Immediate polymerization
Correct Answer: B) No appreciable reaction under those conditions
19. Steam cracking of light alkanes mainly gives alkenes by processes involving:
A) Carbocations only
B) Carbanions only
C) Radical reactions
D) Pericyclic reactions only
Correct Answer: C) Radical reactions
20. The bond cleavage in steam cracking is predominantly:
A) Heterolytic
B) Homolytic
C) Coordinate
D) Concerted ionic
Correct Answer: B) Homolytic
21. Steam cracking is favored at high temperature mainly because of a large positive:
A) $\Delta H°$ only
B) $\Delta S°$ contribution
C) Activation entropy decrease
D) Enthalpy of hydration
Correct Answer: B) $\Delta S°$ contribution
22. The simplest aromatic hydrocarbon is:
A) Cyclohexane
B) Cyclohexene
C) Benzene
D) Toluene
Correct Answer: C) Benzene
23. A compound containing at least one benzene ring is classified as:
A) Aliphatic
B) Aromatic
C) Alicyclic only
D) Saturated only
Correct Answer: B) Aromatic
24. In benzene, the unusual stability is associated with:
A) Localized σ electrons only
B) Delocalized π electrons
C) Presence of a triple bond
D) Lack of resonance
Correct Answer: B) Delocalized π electrons
25. Benzene is less reactive toward addition than alkenes chiefly because benzene:
A) Has no π electrons
B) Is ionic
C) Is aromatically stabilized
D) Contains only sp^3 carbons
Correct Answer: C) Is aromatically stabilized
26. Monosubstituted benzene having a $–CH_3$ group is commonly called:
A) Styrene
B) Toluene
C) Ethylbenzene
D) Xylene
Correct Answer: B) Toluene
27. Monosubstituted benzene having a $–CH=CH_2$ group is:
A) Styrene
B) Toluene
C) Benzaldehyde
D) Cumene
Correct Answer: A) Styrene
28. In Friedel–Crafts alkylation, the catalyst commonly used is:
A) H_2SO_4
B) NaOH
C) $AlCl_3$
D) $KMnO_4$
Correct Answer: C) $AlCl_3$
29. Reaction of benzene with 1-chloropropane/$AlCl_3$ gives isopropylbenzene as major product because of:
A) Radical substitution
B) Carbocation rearrangement
C) Anti addition
D) Hydroboration
Correct Answer: B) Carbocation rearrangement
30. In electrophilic aromatic substitution, the attacked aromatic ring temporarily forms a:
A) Bromonium ion
B) Acetylide anion
C) σ-complex
D) Carbene
Correct Answer: C) σ-complex
31. The electrophile generated during nitration of benzene is:

Chapter 27: Aromatic Compound

1. The molecular formula of benzene is:
A) C_6H_{12}
B) C_6H_6
C) C_6H_8
D) C_6H_{10}
Correct Answer: (B)

2. The index of hydrogen deficiency of benzene is:
A) 1
B) 2
C) 3
D) 4
Correct Answer: (D)

3. Benzene is unexpectedly stable mainly because of:
A) Localized σ bonds only
B) Aromatic delocalization of π electrons
C) Presence of two triple bonds
D) Absence of resonance
Correct Answer: (B)

4. The six carbon atoms of benzene are all:
A) sp-hybridized
B) sp^2-hybridized
C) sp^3-hybridized
D) dsp^2-hybridized
Correct Answer: (B)

5. The geometry at each carbon atom in benzene is approximately:
A) Linear
B) Tetrahedral
C) Trigonal planar
D) Trigonal pyramidal
Correct Answer: (C)

6. The unusual chemical behavior of benzene compared with alkenes is best explained by:
A) High polarity of C–H bonds
B) Aromatic stabilization
C) Presence of a free carbocation
D) Easy addition of halogens
Correct Answer: (B)

7. Benzene reacts with Br_2 in the dark at room temperature:
A) Instantly to give 1,2-dibromocyclohexane
B) Rapidly to give bromobenzene without catalyst
C) Very slowly or not at all without a Lewis acid catalyst
D) Only to give benzene hexabromide
Correct Answer: (C)

8. In electrophilic aromatic substitution, benzene generally undergoes:
A) Addition
B) Substitution
C) Elimination
D) Radical polymerization
Correct Answer: (B)

9. The principal reason benzene prefers substitution over addition is that substitution:
A) Destroys aromaticity completely
B) Retains aromaticity
C) Forms a carbanion
D) Requires no electrophile
Correct Answer: (B)

10. The number of π electrons in benzene is:
A) 2
B) 4
C) 6
D) 8
Correct Answer: (C)

11. According to Hückel's rule, a monocyclic planar fully conjugated ring is aromatic when it contains:
A) $4n$ π electrons
B) $4n + 1$ π electrons
C) $4n + 2$ π electrons
D) $2n$ π electrons
Correct Answer: (C)

12. A planar cyclic conjugated molecule containing 4 π electrons is predicted to be:
A) Aromatic
B) Antiaromatic
C) Noncyclic
D) Saturated
Correct Answer: (B)

13. For aromaticity, a molecule must be:
A) Cyclic, planar, and conjugated
B) Acyclic, planar, and conjugated
C) Cyclic and saturated
D) Planar and ionic only
Correct Answer: (A)

14. Which statement about benzene is correct?
A) Its six C–C bonds alternate permanently between single and double
B) Its six C–C bonds are equivalent
C) It contains one triple bond
D) It is nonplanar
Correct Answer: (B)

15. The heat of hydrogenation of benzene is much less exothermic than expected for a cyclohexatriene because benzene is:
A) Antiaromatic
B) Aromatic
C) Ionic
D) Nonconjugated
Correct Answer: (B)

16. Which species is aromatic?
A) Cyclobutadiene
B) Cyclopentadienyl anion
C) Cyclopentadienyl cation
D) Cycloheptatrienyl radical
Correct Answer: (B)

17. Which of the following is an aromatic cation?
A) Cycloheptatrienyl cation
B) Cyclooctatetraene in tub conformation
C) Cyclobutadiene
D) Cyclopentadienyl cation
Correct Answer: (A)

18. The cyclopentadienyl anion is aromatic because it has:
A) 4 π electrons
B) 5 π electrons
C) 6 π electrons
D) 8 π electrons
Correct Answer: (C)

19. The cycloheptatrienyl cation is aromatic because it contains:
A) 4 π electrons in a planar conjugated ring
B) 6 π electrons in a planar conjugated ring
C) 8 π electrons in a planar conjugated ring
D) 10 π electrons in a nonplanar ring
Correct Answer: (B)

20. Cyclooctatetraene is not aromatic under ordinary conditions mainly because it is:
A) Planar and fully conjugated
B) Nonplanar
C) Saturated
D) Ionic
Correct Answer: (B)

21. The cyclooctatetraene dianion is stabilized because it becomes:
A) Planar and aromatic with 10 π electrons
B) Antiaromatic with 8 π electrons
C) Saturated with 8 σ bonds
D) A radical pair
Correct Answer: (A)

22. Which compound is aromatic?
A) Cyclobutadiene
B) [10]Annulene twisted out of planarity
C) Benzene
D) Cyclopentadienyl cation
Correct Answer: (C)

23. A key reason [10]annulene is not aromatic is that it:
A) Has 8 π electrons
B) Cannot remain planar because of steric crowding
C) Is saturated
D) Contains no p orbitals
Correct Answer: (B)

24. [18]Annulene is aromatic because it is sufficiently large to:
A) Avoid conjugation
B) Remain planar and satisfy 4n + 2
C) Become tetrahedral
D) Lose all ring current effects
Correct Answer: (B)

25. The aromatic stabilization energy of benzene is approximately:
A) 36 kJ/mol
B) 75 kJ/mol
C) 150 kJ/mol
D) 300 kJ/mol
Correct Answer: (C)

26. A compound that reacts with electrophiles mainly by substitution rather than addition is likely to be:
A) Aromatic
B) A simple alkane
C) A carbanion
D) A radical only
Correct Answer: (A)

27. The simplest aromatic hydrocarbon is:
A) Toluene
B) Styrene
C) Benzene
D) Naphthalene
Correct Answer: (C)

28. The common name for methylbenzene is:
A) Styrene
B) Toluene
C) Xylene
D) Cumene
Correct Answer: (B)

Chapter 29: Alcohol, Phenol and Ether

1. The hydroxyl group of an alcohol is directly attached to which kind of carbon atom?
A) A saturated sp^3-hybridized carbon atom
B) An aromatic sp^2 carbon atom
C) A carbonyl carbon atom
D) A vinylic sp^2 carbon atom
Correct Answer: (A)

2. A compound in which the –OH group is attached directly to a benzene ring is called:
A) An alcohol
B) A phenol
C) An enol
D) An ether
Correct Answer: (B)

3. The compound CH_2=CH–OH is best classified as:
A) A primary alcohol
B) A phenol
C) An enol
D) A diol
Correct Answer: (C)

4. The classification of a monohydric alcohol as primary, secondary, or tertiary depends on:
A) The number of hydrogen atoms on oxygen
B) The length of the carbon chain
C) The number of carbon groups attached to the OH-bearing carbon
D) The number of oxygen atoms in the molecule
Correct Answer: (C)

5. Which compound is a primary alcohol?
A) $(CH_3)_3C–OH$
B) $CH_3CH(OH)CH_3$
C) CH_3CH_2OH
D) $(CH_3)_2CHOH$
Correct Answer: (C)

6. Which compound is a secondary alcohol?
A) CH_3OH
B) $CH_3CH_2CH_2OH$
C) $CH_3CH(OH)CH_3$
D) $(CH_3)_3COH$
Correct Answer: (C)

7. Which compound is a tertiary alcohol?
A) CH_3CH_2OH
B) $CH_3CH_2CH_2OH$
C) $CH_3CH(OH)CH_3$
D) $(CH_3)_3COH$
Correct Answer: (D)

8. Benzyl alcohol is best described as:
A) A vinylic alcohol
B) A benzylic alcohol
C) A tertiary alcohol
D) A phenol
Correct Answer: (B)

9. Allyl alcohol is best described as:
A) A benzylic alcohol
B) A phenol
C) An allylic alcohol
D) An ether
Correct Answer: (C)

10. The IUPAC name of CH_3OH is:
A) Methyl alcohol
B) Methanol
C) Hydroxymethane
D) Methanediol
Correct Answer: (B)

11. The IUPAC name of CH_3CH_2OH is:
A) Ethyl alcohol
B) Ethan-2-ol
C) Ethanol
D) Methoxy methane
Correct Answer: (C)

12. The IUPAC name of $CH_3CH(OH)CH_3$ is:
A) Propan-1-ol
B) Propan-2-ol
C) 2-Methyl-1-propanol
D) 2-Propene-1-ol
Correct Answer: (B)

13. The IUPAC name of $(CH_3)_3COH$ is:
A) 2-Methylpropan-2-ol
B) 2-Methylpropan-1-ol
C) Butan-2-ol
D) tert-Butoxy methane
Correct Answer: (A)

14. In IUPAC nomenclature of alcohols, numbering begins from the end nearest the:
A) Largest substituent
B) Double bond
C) Hydroxyl group
D) Branch point
Correct Answer: (C)

15. In naming alcohols, the suffix generally used is:
A) -al
B) -one
C) -ol
D) -oxy
Correct Answer: (C)

16. The correct IUPAC name of $HOCH_2CH_2OH$ is:
A) Ethylene alcohol
B) 1,2-Ethanediol
C) 1-Ethoxyethanol
D) Ethan-1-ol-2-ol
Correct Answer: (B)

17. Glycerol is correctly named in IUPAC nomenclature as:
A) Propane-1,2-diol
B) Propan-1,2,3-triol
C) 1,1,3-Propanetriol
D) 2,3-Propanediol
Correct Answer: (B)
18. The common name of $HOCH_2CH_2OH$ is:
A) Glyoxal
B) Ethylene glycol
C) Propylene glycol
D) Glycerol
Correct Answer: (B)
19. Which statement about naming phenols is correct?
A) Phenols are named as hydroxyalkanes
B) -benzene is always used as the parent suffix
C) -phenol is commonly used as the parent name
D) Phenols are named as alkoxybenzenes
Correct Answer: (C)
20. The correct name for m-methylphenol is:
A) 1-Methylbenzene
B) 3-Methylphenol
C) Benzyl alcohol
D) 2-Methylphenol
Correct Answer: (B)
21. The compound 2,4-dinitrophenol contains:
A) An ether and a ketone
B) An alcohol and an alkene
C) A phenol and two nitro groups
D) Two phenolic groups
Correct Answer: (C)
22. The common naming pattern for simple ethers is:
A) Alkoxyalkane only
B) List both groups alphabetically followed by ether
C) Use the suffix -ol
D) Use oxa- for all ethers
Correct Answer: (B)
23. The IUPAC name of $CH_3OCH_2CH_2CH_2CH_3$ is:
A) Butyl methyl ether
B) 1-Methoxybutane
C) Methoxybutane
D) Butoxy methane
Correct Answer: (B)
24. The compound $CH_3CH_2OCH_2CH_3$ is commonly called:
A) Ethoxyethane
B) Diethyl ether
C) Ethyl alcohol
D) 2-Ethoxyethane
Correct Answer: (B)
25. In IUPAC substitutive nomenclature, ethers are often named as:
A) Hydroxyalkanes
B) Alkanones
C) Alkoxyalkanes
D) Alkanals
Correct Answer: (C)
26. The group $-OCH_3$ is called:
A) Hydroxy
B) Methoxy
C) Methyl
D) Formyl
Correct Answer: (B)
27. The three-membered cyclic ether is called:
A) Oxetane
B) Oxirane
C) Oxolane
D) Dioxane
Correct Answer: (B)
28. The four-membered cyclic ether is called:
A) Oxetane
B) Oxirane
C) Tetrahydrofuran
D) Oxazole
Correct Answer: (A)
29. Tetrahydrofuran is a:
A) Three-membered cyclic ether
B) Four-membered cyclic ether
C) Five-membered cyclic ether
D) Six-membered aromatic ether
Correct Answer: (C)
30. 1,4-Dioxane is best described as a:
A) Monocyclic hydrocarbon
B) Six-membered cyclic diether
C) Five-membered cyclic ether
D) Three-membered epoxide
Correct Answer: (B)
31. Alcohols generally have higher boiling points than comparable ethers because alcohols:
A) Are more symmetrical
B) Undergo self-hydrogen bonding
C) Have lower molecular masses
D) Are stronger oxidizing agents
Correct Answer: (B)
32. Ethers generally have boiling points close to those of hydrocarbons of similar molecular mass because ethers:
A) Cannot undergo intermolecular hydrogen bonding with themselves
B) Are ionic
C) Contain acidic hydrogen
D) Possess carbonyl groups
Correct Answer: (A)
33. Which compound has the highest boiling point among the following?
A) Pentane

Chapter 30: Carbonyl Compounds

1. The carbonyl carbon in aldehydes is best described as:
A) sp^3 hybridized and nucleophilic
B) sp^2 hybridized and electrophilic
C) sp hybridized and neutral
D) sp^3 hybridized and electrophilic
Correct Answer: (B)

2. Which compound is more reactive toward nucleophilic addition?
A) $(CH_3)_2CO$
B) CH_3CHO
C) $C_6H_5COCH_3$
D) $(CH_3)_3CCHO$
Correct Answer: (B)

3. The major factor responsible for higher reactivity of aldehydes over ketones is:
A) Hyperconjugation
B) Steric hindrance and inductive effect
C) Resonance stabilization
D) Aromaticity
Correct Answer: (B)

4. In nucleophilic addition, the first step involves:
A) Proton abstraction
B) Nucleophilic attack on carbonyl carbon
C) Elimination of water
D) Formation of carbocation
Correct Answer: (B)

5. Which reagent converts aldehydes to primary alcohols?
A) $KMnO_4$
B) $NaBH_4$
C) PCC
D) H_2SO_4
Correct Answer: (B)

6. The product of CH_3CHO + HCN is:
A) Alcohol
B) Cyanohydrin
C) Ketone
D) Acid
Correct Answer: (B)

7. The intermediate formed in nucleophilic addition is:
A) Carbocation
B) Carbanion
C) Tetrahedral intermediate
D) Radical
Correct Answer: (C)

8. Which aldehyde is known to exist extensively as its hydrate because of the strong electron-withdrawing effect of three chlorine atoms?
A) Ethanal
B) Benzaldehyde
C) Chloral (CCl_3CHO)
D) Acetone
Correct Answer: (C)

9. Acetal formation requires:
A) Base catalyst
B) Acid catalyst
C) Heat only
D) UV light
Correct Answer: (B)

10. Which compound gives iodoform test?
A) CH_3CHO
B) HCHO
C) C_6H_5CHO
D) CH_3CH_2CHO
Correct Answer: (A)

11. Aldol reaction requires:
A) No α-hydrogen
B) α-hydrogen presence
C) Aromatic ring
D) Strong oxidizing agent
Correct Answer: (B)

12. Base used in aldol reaction is commonly:
A) HCl
B) NaOH
C) H_2SO_4
D) NaCl
Correct Answer: (B)

13. Aldol condensation product after dehydration is:
A) Alcohol
B) Enone
C) Acid
D) Ester
Correct Answer: (B)

14. Which reagent converts aldehydes and ketones into gem-dichlorides?
A) PCl_5
B) $NaBH_4$
C) HCN/KCN
D) Tollens' reagent
Correct Answer: (A)

15. Grignard reagent reacts with aldehyde to give:
A) Primary alcohol
B) Secondary alcohol
C) Tertiary alcohol
D) Ketone
Correct Answer: (B)

16. Formaldehyde + RMgX gives:
A) Secondary alcohol
B) Primary alcohol
C) Tertiary alcohol

D) Ketone
Correct Answer: (B)
17. Ketone + RMgX produces:
A) Primary alcohol
B) Secondary alcohol
C) Tertiary alcohol
D) Ester
Correct Answer: (C)
18. Which reagent selectively oxidizes aldehydes but not ketones?
A) PCC
B) Tollens' reagent
C) $LiAlH_4$
D) $NaBH_4$
Correct Answer: (B)
19. Silver mirror test is given by:
A) Ketones
B) Aldehydes
C) Alcohols
D) Alkenes
Correct Answer: (B)
20. Fehling's solution distinguishes aldehydes by forming:
A) Blue precipitate
B) Red precipitate
C) White precipitate
D) Green precipitate
Correct Answer: (B)
21. Which aldehyde does NOT give Fehling's test?
A) CH_3CHO
B) HCHO
C) C_6H_5CHO
D) CH_3CH_2CHO
Correct Answer: (C)
22. Wittig reaction converts carbonyl compound into:
A) Alcohol
B) Alkene
C) Acid
D) Ester
Correct Answer: (B)
23. Reagent used in Wittig reaction is:
A) Phosphonium ylide
B) Grignard reagent
C) NaOH
D) $KMnO_4$
Correct Answer: (A)
24. Enolate ion is stabilized by:
A) Hyperconjugation
B) Resonance
C) Inductive effect only
D) Steric hindrance
Correct Answer: (B)
25. α-Hydrogen acidity is due to:
A) Hyperconjugation
B) Resonance stabilization of enolate
C) Steric strain
D) Aromaticity
Correct Answer: (B)
26. Keto form is more stable than enol due to:
A) Hydrogen bonding
B) Strong C=O bond
C) Steric hindrance
D) Aromaticity
Correct Answer: (B)
27. Enol form is favored in:
A) Simple aldehydes
B) β-dicarbonyl compounds
C) Ketones only
D) Alcohols
Correct Answer: (B)
28. Which intermediate is planar?
A) sp^3 carbon
B) sp^2 carbonyl carbon
C) sp carbon
D) Radical carbon
Correct Answer: (B)
29. Major product of acetaldehyde aldol is:
A) Ethanol
B) 3-hydroxybutanal
C) Acetic acid
D) Butanone
Correct Answer: (B)
30. Which reaction forms C–C bond?
A) Oxidation
B) Aldol reaction
C) Reduction
D) Hydrolysis
Correct Answer: (B)
31. Claisen condensation occurs between:
A) Aldehydes
B) Ketones
C) Esters
D) Alcohols
Correct Answer: (C)
32. Michael addition involves:
A) 1,2-addition
B) 1,4-addition
C) Substitution
D) Elimination
Correct Answer: (B)
33. Which compound undergoes conjugate addition?
A) Saturated aldehyde
B) α,β-unsaturated carbonyl
C) Alcohol

Chapter 31: Carboxylic Acids

1. Which of the following correctly represents the mechanism of nucleophilic acyl substitution?
A) Nucleophilic addition followed by protonation only
B) Nucleophilic addition followed by elimination of leaving group
C) Electrophilic addition followed by elimination
D) Radical substitution followed by rearrangement
Correct Answer: (B)

2. Which carboxylic acid derivative is most reactive towards nucleophilic acyl substitution?
A) Amide
B) Ester
C) Acid chloride
D) Carboxylate
Correct Answer: (C)

3. The leaving group ability order in acyl substitution is best represented as:
A) $NH_2^- > OR^- > Cl^-$
B) $Cl^- > RCOO^- > OR^- > NH_2^-$
C) $OR^- > NH_2^- > Cl^-$
D) $NH_2^- > Cl^- > OR^-$
Correct Answer: (B)

4. Which intermediate is formed during nucleophilic acyl substitution?
A) Carbocation
B) Carbanion
C) Tetrahedral intermediate
D) Radical intermediate
Correct Answer: (C)

5. Which compound undergoes nucleophilic substitution most slowly?
A) RCOCl
B) $(RCO)_2O$
C) RCOOR′
D) $RCONH_2$
Correct Answer: (D)

6. The hydrolysis of an ester under acidic conditions produces:
A) Alcohol + aldehyde
B) Alcohol + carboxylic acid
C) Ketone + alcohol
D) Amine + acid
Correct Answer: (B)

7. Which reagent converts carboxylic acid into acid chloride?
A) NaOH
B) $SOCl_2$
C) H_2SO_4
D) $NaBH_4$
Correct Answer: (B)

8. Which product is formed when an acid chloride reacts with ammonia?
A) Ester
B) Amide
C) Alcohol
D) Aldehyde
Correct Answer: (B)

9. Which compound shows strongest acidity?
A) CH_3COOH
B) $CH_2ClCOOH$
C) $CHCl_2COOH$
D) CCl_3COOH
Correct Answer: (D)

10. The increased acidity of haloacids is due to:
A) Hyperconjugation
B) Inductive electron withdrawal
C) Resonance donation
D) Steric hindrance
Correct Answer: (B)

11. Which derivative is least reactive due to resonance stabilization?
A) Acid chloride
B) Ester
C) Amide
D) Anhydride
Correct Answer: (C)

12. The major product of hydrolysis of nitrile is:
A) Alcohol
B) Carboxylic acid
C) Aldehyde
D) Ketone
Correct Answer: (B)

13. Which compound has highest boiling point?
A) Alkane
B) Alcohol
C) Carboxylic acid
D) Ether
Correct Answer: (C)

14. Dimer formation in carboxylic acids is due to:
A) Ionic bonding
B) Hydrogen bonding
C) Covalent bonding
D) Metallic bonding
Correct Answer: (B)

15. Which reagent converts ester to alcohol?
A) $LiAlH_4$
B) NaCl
C) HCl
D) $KMnO_4$
Correct Answer: (A)

16. The geometry of carbonyl carbon in carboxylic acid is:
A) sp^3

B) sp^2
C) sp
D) d^2sp^3
Correct Answer: (B)
17. Which compound shows resonance stabilization in conjugate base?
A) Alcohol
B) Carboxylic acid
C) Alkane
D) Ether
Correct Answer: (B)
18. Which product is formed when ester reacts with Grignard reagent?
A) Primary alcohol
B) Secondary alcohol
C) Tertiary alcohol
D) Ketone
Correct Answer: (C)
19. Which reaction produces acid anhydride?
A) Two carboxylic acids dehydration
B) Alcohol oxidation
C) Ester hydrolysis
D) Reduction of acid
Correct Answer: (A)
20. Which compound gives amide on heating with ammonia?
A) Ester
B) Acid chloride
C) Alkane
D) Alkene
Correct Answer: (B)
21. Which factor increases acidity of carboxylic acids?
A) Electron donating group
B) Electron withdrawing group
C) Alkyl substitution
D) Hyperconjugation
Correct Answer: (B)
22. Which derivative hydrolyzes fastest in water?
A) Amide
B) Ester
C) Acid chloride
D) Carboxylate
Correct Answer: (C)
23. Which compound is formed when ester reacts with excess alcohol in acid?
A) Amide
B) Ether
C) Transesterified product
D) Aldehyde
Correct Answer: (C)
24. The conjugate base of carboxylic acid is stabilized by:
A) Inductive effect only
B) Resonance only
C) Both inductive and resonance
D) Hyperconjugation only
Correct Answer: (C)
25. Which compound shows highest solubility in water?
A) Long chain acid
B) Short chain acid
C) Ester
D) Amide
Correct Answer: (B)
26. Which reaction forms ester from acid?
A) Oxidation
B) Fischer esterification
C) Reduction
D) Hydrolysis
Correct Answer: (B)
27. Which compound has strongest hydrogen bonding?
A) Ether
B) Alcohol
C) Carboxylic acid
D) Alkane
Correct Answer: (C)
28. Which derivative has poorest leaving group?
A) Cl^-
B) $RCOO^-$
C) OR^-
D) NH_2^-
Correct Answer: (D)
29. Which reaction produces amide from ester?
A) Hydrolysis
B) Aminolysis
C) Oxidation
D) Reduction
Correct Answer: (B)
30. Which compound is formed by reduction of acid chloride?
A) Alcohol
B) Aldehyde
C) Ketone
D) Ester
Correct Answer: (B)
31. Which derivative is most stable thermodynamically?
A) Acid chloride
B) Anhydride
C) Ester
D) Amide
Correct Answer: (D)
32. Which reagent converts nitrile to amide?
A) Strong acid partial hydrolysis
B) Base hydrolysis complete
C) Reduction

Chapter 32: Periodic Table

1. Which scientist arranged the then known elements into triads in 1829?
A) Al-Razi
B) Dobereiner
C) Newland
D) Moseley
Correct Answer: (B)

2. The classification proposed by Newland was based on the observation that every _____ element had properties similar to the first one.
A) sixth
B) seventh
C) eighth
D) ninth
Correct Answer: (C)

3. Newland arranged 62 known elements in increasing order of their:
A) atomic numbers
B) valencies
C) atomic masses
D) densities
Correct Answer: (C)

4. The principle on which Newland's classification was based is called the:
A) Periodic Law
B) Law of Triads
C) Law of Octaves
D) Law of Valency
Correct Answer: (C)

5. The scientist who presented the first regular periodic table in 1871 was:
A) Newland
B) Moseley
C) Mendeleev
D) Dobereiner
Correct Answer: (C)

6. Mendeleev arranged elements primarily in order of increasing:
A) atomic number
B) atomic mass
C) density
D) melting point
Correct Answer: (B)

7. Mendeleev left gaps in his periodic table because he:
A) did not know all atomic numbers
B) expected undiscovered elements to exist
C) rejected non-metals
D) omitted transition elements intentionally
Correct Answer: (B)

8. Which element was successfully predicted by Mendeleev before its discovery?
A) Neon
B) Germanium
C) Helium
D) Argon
Correct Answer: (B)

9. A later major improvement in Mendeleev's table was the addition of group VIIIA containing:
A) alkali metals
B) halogens
C) noble gases
D) lanthanides
Correct Answer: (C)

10. The discovery of atomic number that improved periodic classification is associated with:
A) Al-Razi
B) Moseley
C) Newland
D) Dalton
Correct Answer: (B)

11. After Moseley's work, elements were more satisfactorily classified by using their:
A) atomic volumes
B) atomic masses
C) atomic numbers
D) oxidation states
Correct Answer: (C)

12. The modern periodic law states that when elements are arranged in ascending order of atomic numbers, their chemical properties:
A) disappear completely
B) remain constant
C) repeat periodically
D) become identical
Correct Answer: (C)

13. The development of the periodic table is one of the most significant achievements in the history of:
A) biology
B) chemical sciences
C) geology
D) astronomy
Correct Answer: (B)

14. In Mendeleev's periodic table, the horizontal rows were called:
A) groups
B) families
C) periods
D) blocks
Correct Answer: (C)

15. In the modern periodic table, vertical

columns are called:
A) shells
B) periods
C) groups
D) blocks
Correct Answer: (C)
16. The horizontal rows of the periodic table are called:
A) families
B) periods
C) groups
D) classes
Correct Answer: (B)
17. The total number of periods in the modern periodic table is:
A) 5
B) 6
C) 7
D) 8
Correct Answer: (C)
18. Period 1 contains only:
A) hydrogen and lithium
B) hydrogen and helium
C) helium and neon
D) lithium and beryllium
Correct Answer: (B)
19. Periods 2 and 3 are called short periods because each contains:
A) 2 elements
B) 8 elements
C) 18 elements
D) 32 elements
Correct Answer: (B)
20. Periods 4 and 5 are called long periods because each contains:
A) 8 elements
B) 16 elements
C) 18 elements
D) 32 elements
Correct Answer: (C)
21. Period 6 contains how many elements?
A) 18
B) 24
C) 30
D) 32
Correct Answer: (D)
22. The seventh period is:
A) completely filled
B) incomplete so far
C) the shortest period
D) containing only representative elements
Correct Answer: (B)
23. The period in which repetition of properties occurs after 18 elements is:
A) period 1 only
B) periods 2 and 3
C) periods 4 and 5
D) period 7 only
Correct Answer: (C)
24. After K (atomic number 19), the next element with similar properties is:
A) Ca
B) Rb
C) Sr
D) Cs
Correct Answer: (B)
25. Lanthanides begin after:
A) 56Ba
B) 57La
C) 58Ce
D) 89Ac
Correct Answer: (B)
26. Actinides follow:
A) 57La
B) 71Lu
C) 89Ac
D) 87Fr
Correct Answer: (C)
27. Lanthanides and actinides are usually shown separately at the bottom of the periodic table because they belong to the:
A) gaseous state
B) inner transition series
C) noble gas family
D) p-block
Correct Answer: (B)
28. In the traditional system, each group is divided into:
A) metallic and non-metallic parts
B) upper and lower halves
C) A and B subgroups
D) s and p subgroups
Correct Answer: (C)
29. In the traditional notation, representative or normal elements are placed in:
A) B subgroups
B) A subgroups
C) f-block only
D) zero group only
Correct Answer: (B)
30. B subgroups mainly contain:
A) noble gases
B) representative elements
C) transition elements
D) halogens
Correct Answer: (C)
31. The confusion in Mendeleev's table involving Be, Mg, Ca, Sr, Ba and Zn, Cd, Hg was removed by:

Chapter 34: Transition Elements

1. Transition elements are generally defined as elements having:
A) Completely filled d-orbitals
B) Partially filled d- or f-orbitals in atoms or ions
C) Only filled p-orbitals
D) Only s-electrons
Correct Answer: (B)

2. Transition elements are located between:
A) s- and p-block elements
B) p- and f-block elements
C) s- and f-block elements
D) d and f block elements
Correct Answer: (A)

3. The main transition elements belong to the:
A) s-block
B) p-block
C) d-block
D) f-block
Correct Answer: (C)

4. The inner transition elements belong to:
A) p-block
B) s-block
C) f-block
D) d-block
Correct Answer: (C)

5. The first transition series involves filling of:
A) 2d orbitals
B) 3d orbitals
C) 4d orbitals
D) 5d orbitals
Correct Answer: (B)

6. The second transition series involves filling of:
A) 3d orbitals
B) 4d orbitals
C) 5d orbitals
D) 6d orbitals
Correct Answer: (B)

7. The third transition series involves filling of:
A) 4d orbitals
B) 5d orbitals
C) 6d orbitals
D) 3d orbitals
Correct Answer: (B)

8. The first transition series starts from:
A) Ti
B) Sc
C) V
D) Cr
Correct Answer: (B)

9. In the strict sense, the first transition series ends at:
A) Cu
B) Zn
C) Ni
D) Fe
Correct Answer: (A)

10. Zinc is not considered a transition element because:
A) It is radioactive
B) It has fully filled d-orbitals
C) It is non-metal
D) It has no s-electrons
Correct Answer: (B)

11. Transition metals are generally:
A) Non-metals
B) Metalloids
C) Metals
D) Noble gases
Correct Answer: (C)

12. Transition metals are typically:
A) Low melting
B) Soft
C) High melting
D) Non-conductors
Correct Answer: (C)

13. Transition metals conduct:
A) Only electricity
B) Only heat
C) Both heat and electricity
D) Neither heat nor electricity
Correct Answer: (C)

14. Transition metals form alloys because:
A) They are inert
B) They have similar atomic sizes
C) They are non-metallic
D) They have low density
Correct Answer: (B)

15. Variable oxidation states in transition metals arise due to:
A) Large atomic size
B) Similar energies of the d- and s-orbitals
C) High electronegativity
D) Low density
Correct Answer: (B)

16. Coloured compounds of transition metals are due to:
A) s-electron transitions
B) p-electron transitions
C) d-d transitions
D) Nuclear transitions
Correct Answer: (C)

17. Paramagnetism in transition metals is due to:

A) Paired electrons
B) Unpaired electrons
C) Nuclear spin
D) Ionic bonding
Correct Answer: (B)

18. Transition metals often act as:
A) Insulators
B) Catalysts
C) Acids
D) Bases
Correct Answer: (B)

19. Catalytic activity of transition metals is due to:
A) Large size
B) Variable oxidation states
C) Inert nature
D) Low melting point
Correct Answer: (B)

20. A ligand is defined as:
A) Electron acceptor
B) Electron donor species
C) Proton donor
D) Metal ion
Correct Answer: (B)

21. The coordination number represents:
A) Number of electrons
B) Number of donor atoms directly attached to the central metal ion
C) Oxidation state
D) Atomic number
Correct Answer: (B)

22. Monodentate ligands bind through:
A) Two sites
B) One site
C) Three sites
D) No site
Correct Answer: (B)

23. Bidentate ligands bind through:
A) One donor atom
B) Two donor atoms
C) Three donor atoms
D) Four donor atoms
Correct Answer: (B)

24. EDTA is an example of:
A) Monodentate ligand
B) Bidentate ligand
C) Polydentate ligand
D) Neutral ligand
Correct Answer: (C)

25. Complex compounds are formed due to:
A) Ionic bonding only
B) Covalent bonding only
C) Coordinate bonding
D) Hydrogen bonding
Correct Answer: (C)

26. Transition metals show high melting points because:
A) Weak bonding
B) Strong metallic bonding
C) Ionic bonding
D) Covalent bonding
Correct Answer: (B)

27. Transition metals form colored ions due to:
A) Charge transfer
B) d-orbital splitting
C) Nuclear transitions
D) Proton transfer
Correct Answer: (B)

28. The oxidation state of Mn in MnO_4^- is:
A) +5
B) +6
C) +7
D) +4
Correct Answer: (C)

29. The oxidation state of Cr in $Cr_2O_7^{2-}$ is:
A) +3
B) +4
C) +6
D) +2
Correct Answer: (C)

30. $KMnO_4$ acts as:
A) Reducing agent
B) Oxidizing agent
C) Catalyst
D) Neutral salt
Correct Answer: (B)

31. Potassium dichromate acts as:
A) Oxidizing agent
B) Reducing agent
C) Catalyst
D) Acid
Correct Answer: (A)

32. The electronic configuration of Cu is:
A) $3d^9 4s^2$
B) $3d^{10} 4s^1$
C) $3d^8 4s^2$
D) $3d^7 4s^2$
Correct Answer: (B)

33. The electronic configuration of Cr is:
A) $3d^4 4s^2$
B) $3d^5 4s^1$
C) $3d^6 4s^0$
D) $3d^3 4s^2$
Correct Answer: (B)

34. The stability of half-filled orbitals is due to:
A) Nuclear charge
B) Exchange energy
C) Ionic bonding
D) Shielding
Correct Answer: (B)