CUET PG Nanascience - 2025 Question Paper with Solutions

Time Allowed :1 Hour	Maximum Marks :300	Total Questions :75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 1 hour duration.
2. The question paper consists of 75 questions. The maximum marks are 300.
3. 4 marks are awarded for every correct answer, and 1 mark is deducted for every wrong answer.

1. Micro-organisms responsible for nitrification are

(1) Nitrosomonas and Nitrobacter
(2) Nostoc and Anabaena
(3) Rhizobium and Azotobacter
(4) Clostridium and Pseudomonas

Correct Answer: (1) Nitrosomonas and Nitrobacter
Solution: Step 1: Understanding nitrification.
Nitrification is the biological oxidation of ammonia (NH_3) to nitrite (NO_2^-) and then to nitrate (NO_3^-).
Step 2: Micro-organisms involved.
- Nitrosomonas oxidizes ammonia into nitrite.
- Nitrobacter oxidizes nitrite into nitrate.

Thus, the micro-organisms responsible for nitrification are Nitrosomonas and Nitrobacter.

Final Answer:

Nitrosomonas and Nitrobacter

Quick Tip

Remember: Nitrification involves two steps – ammonia to nitrite (Nitrosomonas) and nitrite to nitrate (Nitrobacter).

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2. Widal test is designed specifically for the diagnosis of

(1) Tuberculosis
(2) Typhoid
(3) Dengue

(4) Chikungunya

Correct Answer: (2) Typhoid
Solution: Step 1: Understanding the Widal test.
The Widal test is a serological test that detects antibodies (O and H agglutinins) against *Salmonella typhi*.

Step 2: Clinical use.
Since *Salmonella typhi* is the causative agent of typhoid fever, the Widal test is specifically used to diagnose typhoid.

Final Answer:

$$\boxed{\text{Typhoid}}$$

Quick Tip

Widal test = Typhoid diagnosis; it checks antibody response to *Salmonella typhi*.

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3. The genetic material in retroviruses are

(1) RNA
(2) ssDNA
(3) dsDNA
(4) ds circular DNA

Correct Answer: (1) RNA
Solution: Step 1: Understanding retroviruses.
Retroviruses, such as HIV, are RNA viruses that use reverse transcriptase to synthesize DNA from their RNA genome.

Step 2: Identifying the genetic material.
Their genetic material is single-stranded RNA, which is reverse transcribed into DNA inside the host cell.

Final Answer:

$$\boxed{\text{RNA}}$$

Quick Tip

Retroviruses are RNA viruses that carry reverse transcriptase enzyme for replication.

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4. Barr body is found in

(1) Normal female germ cell
(2) Normal male germ cells

(3) Normal female somatic cells
(4) Normal male somatic cells

Correct Answer: (3) Normal female somatic cells
Solution: Step 1: Understanding Barr body.
A Barr body is an inactivated X chromosome found in the nucleus of somatic cells in females.

Step 2: Identifying location.
Since females have two X chromosomes, one becomes inactivated in somatic cells to maintain dosage compensation. Hence, Barr bodies are present in normal female somatic cells.

Final Answer:

$$\boxed{\text{Normal female somatic cells}}$$

Quick Tip

Barr body = inactivated X chromosome seen in female somatic cells.

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5. Superoxide dismutase is involved in the conversion of

(1) NADP to NADPH
(2) Superoxide to Hydrogen peroxide
(3) Hydrogen peroxide to hyphohalite
(4) FAD to FADH

Correct Answer: (2) Superoxide to Hydrogen peroxide
Solution: Step 1: Understanding superoxide dismutase.
Superoxide dismutase (SOD) is an important antioxidant enzyme that protects cells from oxidative stress.

Step 2: Reaction catalyzed.
It catalyzes the dismutation of superoxide radicals (O_2^-) into hydrogen peroxide (H_2O_2) and oxygen (O_2):

$$2O_2^- + 2H^+ \longrightarrow H_2O_2 + O_2$$

Final Answer:

$$\boxed{\text{Superoxide to Hydrogen peroxide}}$$

Quick Tip

SOD protects cells by converting toxic superoxide radicals into less harmful hydrogen peroxide.

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6. Which of the following is not a characteristic of a secondary immune response?

(1) IgG isotype
(2) Low affinity antibodies
(3) High affinity antibodies
(4) Short or no Lag phase

Correct Answer: (2) Low affinity antibodies
Solution: Step 1: Understanding primary vs. secondary immune response.
- Primary response: slower, longer lag phase, lower affinity antibodies (mainly IgM).
- Secondary response: rapid, short or no lag phase, high affinity antibodies (mainly IgG).

Step 2: Eliminating incorrect options.
- IgG is characteristic of secondary response.
- High affinity antibodies are produced in secondary response.
- Short/no lag phase is also typical of secondary response.
Thus, "Low affinity antibodies" is not a characteristic.

Final Answer:

$$\boxed{\text{Low affinity antibodies}}$$

Quick Tip

Secondary immune response is faster, stronger, and produces high-affinity IgG antibodies.

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7. Malignant cancer cells have all of the following properties except

(1) unregulated cell division
(2) inhibition of angiogenesis
(3) resistance to apoptosis
(4) cellular immortality

Correct Answer: (2) inhibition of angiogenesis
Solution: Step 1: Properties of malignant cells.
Malignant cancer cells are characterized by:
- Unregulated/continuous cell division.
- Ability to resist apoptosis (programmed cell death).
- Cellular immortality (no replicative senescence).
- **Induction** of angiogenesis to provide blood supply for rapid growth.

Step 2: Identifying the exception.
Since malignant cells promote (not inhibit) angiogenesis, the incorrect option is "inhibition of angiogenesis."

Final Answer:

$$\boxed{\text{inhibition of angiogenesis}}$$

Quick Tip

Cancer cells induce angiogenesis to obtain nutrients and oxygen for uncontrolled growth.

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8. How do eukaryotic genome differ from prokaryotic genomes?

(1) DNA is circular and single stranded in prokaryotes
(2) Intervening sequences are present in eukaryotic DNA
(3) DNA is complexed with histones in prokaryotes
(4) DNA is organised into operons in eukaryotes

Correct Answer: (2) Intervening sequences are present in eukaryotic DNA
Solution: Step 1: Prokaryotic genome features.
- DNA is usually circular, double-stranded.
- DNA lacks histones (except in some archaea).
- Genes are often organized into operons.

Step 2: Eukaryotic genome features.
- DNA is linear and associated with histones.
- Genes contain introns (intervening sequences) that require splicing.

Step 3: Conclusion.
The main distinguishing feature is the presence of **intervening sequences (introns)** in eukaryotic DNA.

Final Answer:

Intervening sequences are present in eukaryotic DNA

Quick Tip

Remember: Introns (non-coding sequences) are unique to eukaryotic genomes.

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9. Each individual antigenic determinant of the variable region of the antibody is referred to as:

(1) paratope
(2) epitope
(3) agretope
(4) idiotope

Correct Answer: (4) idiotope
Solution: Step 1: Understanding terms.
- **Paratope**: Antigen-binding site of the antibody.
- **Epitope**: Antigenic determinant present on the antigen.

- **Agretope**: Part of antigen that binds to MHC molecules.
- **Idiotope**: Each unique antigenic determinant in the variable region of the antibody itself.

Step 2: Conclusion.
Thus, the correct term for antigenic determinants of the antibody variable region is idiotope.

Final Answer:

idiotope

Quick Tip

Epitope = antigen's determinant, Paratope = antibody's binding site, Idiotope = antibody's unique variable determinant.

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10. Which of the following physiological effects is caused in plants by gibberellic acid?

(1) Shortening of genetically tall plants
(2) Elongation of genetically dwarf plants
(3) Rooting in stem cuttings
(4) Yellowing of young leaves

Correct Answer: (2) Elongation of genetically dwarf plants
Solution: Step 1: Role of gibberellic acid.
Gibberellins are plant hormones that promote stem elongation, seed germination, and flowering.

Step 2: Identifying the physiological effect.
In genetically dwarf plants, gibberellic acid stimulates internode elongation, leading to normal height growth.

Final Answer:

Elongation of genetically dwarf plants

Quick Tip

Gibberellins are "growth-promoting hormones" responsible for stem elongation and breaking dormancy.

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11. Which of the following is incorrect about racemic mixture?

(1) Racemic mixture causes finite rotation of plane polarized light
(2) It is often designated as (±)
(3) (+)-2-butanol is a racemic mixture
(4) Plane polarized light remains invariant inside a racemic mixture

Correct Answer: (1) Racemic mixture causes finite rotation of plane polarized light

Solution: Step 1: Understanding racemic mixtures.
A racemic mixture contains equal amounts of two enantiomers (optical isomers). Their optical rotations cancel each other.

Step 2: Correct statements.
- Designated as (±).
- Plane polarized light remains unchanged because optical activities cancel.
- (+)-2-butanol alone is not racemic, but if mixed with its (−) enantiomer in equal proportion, it forms a racemic mixture.

Step 3: Identifying the incorrect option.
Since racemic mixtures are optically inactive, they do **not** cause finite rotation of plane polarized light.

Final Answer:

$$\boxed{\text{Racemic mixture causes finite rotation of plane polarized light (Incorrect)}}$$

Quick Tip

Racemic mixtures are optically inactive because the optical effects of enantiomers cancel each other.

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12. The Russian Chemist, Mendeleev, is remembered for organizing the elements into periodic table. He received many honours, the greatest of which is having an element named after him. Element Mendelevium.

(1) 100
(2) 101
(3) 102
(4) 103

Correct Answer: (2) 101
Solution: Step 1: Identifying the element.
Mendelevium (Md) is a synthetic element in the actinide series of the periodic table.

Step 2: Atomic number.
Mendelevium has an atomic number of **101**.

Final Answer:

$$\boxed{101}$$

Quick Tip

Mendelevium (Md) is an actinide with atomic number 101, named in honor of Dmitri Mendeleev.

13. Which of the following is not a characteristic of a catalyst?

(1) A catalyst lowers the activation energy of a reaction
(2) A catalyst increases the speed of a reaction
(3) Only a small quantity of catalyst is needed in a chemical reaction
(4) A catalyst is used up during the reaction

Correct Answer: (4) A catalyst is used up during the reaction
Solution: Step 1: Define a catalyst.
A catalyst provides an alternative reaction pathway with a lower activation energy and increases the reaction rate without undergoing permanent chemical change.

Step 2: Check each statement.
(1) True — Lower E_a (see Arrhenius: $k = Ae^{-E_a/RT}$).
(2) True — Rate increases due to larger k.
(3) True — Small amounts suffice because a catalyst is regenerated each cycle (high turnover).
(4) False — A catalyst is *not* consumed; it remains chemically unchanged overall.

Final Answer:

A catalyst is used up during the reaction

Quick Tip

Remember: Catalyst $\downarrow E_a$, $\uparrow$ rate, and is regenerated — it's *not* consumed.

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14. Reduction has taken place if a substance.....

(1) gains oxygen
(2) increase its oxidation state
(3) gains hydrogen
(4) loses electrons

Correct Answer: (3) gains hydrogen
Solution: Step 1: Recall equivalent definitions.
Reduction = gain of electrons, loss of oxygen, gain of hydrogen, or $\downarrow$ oxidation number.

Step 2: Evaluate options.
(1) Gain of oxygen $\Rightarrow$ oxidation (not reduction).
(2) Increase in oxidation state $\Rightarrow$ oxidation.
(3) Gain of hydrogen $\Rightarrow$ reduction (correct).
(4) Loss of electrons $\Rightarrow$ oxidation (reduction is gain of electrons).

Final Answer:

gains hydrogen

Quick Tip

OIL RIG: Oxidation Is Loss (of e^-), Reduction Is Gain (of e^-). Reduction often = hydrogenation.

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15. Reaction of alkanes with halogens such as chlorine and bromine proceeds through.....

(1) Free radical substitution mechanism
(2) Electrophilic substitution mechanism
(3) Nucleophilic substitution mechanism
(4) Decomposition mechanism

Correct Answer: (1) Free radical substitution mechanism
Solution: Step 1: Identify hallmark mechanism.
Halogenation of alkanes (e.g., methane) under light/heat follows a *free radical chain* mechanism.

Step 2: Outline the steps (example with Cl_2).
Initiation: $Cl_2 \xrightarrow{h\nu/\Delta} 2\,Cl\cdot$ (homolysis).
Propagation:

$$Cl\cdot + CH_4 \rightarrow HCl + CH_3\cdot$$
$$CH_3\cdot + Cl_2 \rightarrow CH_3Cl + Cl\cdot$$

Termination: Radical–radical coupling (e.g., $Cl\cdot + Cl\cdot \rightarrow Cl_2$).

Step 3: Conclusion.
Thus, the process is **free radical substitution**.

Final Answer:

$$\boxed{\text{Free radical substitution mechanism}}$$

Quick Tip

Think "halogen + light/heat" $\Rightarrow$ radical chain: initiation, propagation, termination.

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16. ..... is the breaking down of long chain hydrocarbons into smaller molecules.

(1) Decomposition
(2) Catenation
(3) Cracking
(4) Combustion

Correct Answer: (3) Cracking

Solution: Step 1: Understanding the process.
Cracking is a process in petroleum refining where high molecular weight hydrocarbons (long chains) are broken into smaller, more useful hydrocarbons.

Step 2: Types of cracking.
- Thermal cracking (heat).
- Catalytic cracking (using zeolite catalysts).

Step 3: Eliminate other options.
- Decomposition: general breakdown, not specific to hydrocarbons.
- Catenation: ability of atoms (like carbon) to form chains.
- Combustion: reaction with oxygen giving CO_2 and H_2O.

Thus, the correct answer is **Cracking**.

Final Answer:

$$\boxed{\text{Cracking}}$$

Quick Tip

Cracking improves fuel quality by producing smaller hydrocarbons like petrol and LPG.

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17. Which of the following set consists of only planar species?

(1) XeF_4, BF_3, PCl_3
(2) XeF_4, AlF_3, NCl_3
(3) XeF_6, BF_3, $AlCl_3$
(4) XeF_4, BF_3, BCl_3

Correct Answer: (4) XeF_4, BF_3, BCl_3
Solution: Step 1: Recall molecular geometries.
- XeF_4: Square planar (due to 2 lone pairs on Xe).
- BF_3: Trigonal planar (sp^2-hybridized).
- BCl_3: Trigonal planar (sp^2-hybridized).
- PCl_3, NCl_3: Trigonal pyramidal (due to lone pairs) $\rightarrow$ not planar.
- XeF_6: Distorted octahedral $\rightarrow$ not planar.

Step 2: Correct combination.
Only option (4) has all planar species: XeF_4, BF_3, BCl_3.

Final Answer:

$$\boxed{XeF_4,\ BF_3,\ BCl_3}$$

Quick Tip

Planar species often arise from sp^2 hybridization (trigonal planar) or dsp^2 (square planar).

18. Which of the following is the most reactive aldehyde towards nucleophilic addition reactions?

(1) Formaldehyde
(2) Acetaldehyde
(3) Crotonaldehyde
(4) Benzaldehyde

Correct Answer: (1) Formaldehyde
Solution: Step 1: Reactivity principle.
Nucleophilic addition to aldehydes depends on: - Electronic effects (electron-donating/withdrawing groups).
- Steric hindrance (bulkiness near carbonyl carbon).

Step 2: Compare aldehydes.
- Formaldehyde ($HCHO$): No alkyl or aryl group $\rightarrow$ least steric hindrance, highly electrophilic.
- Acetaldehyde (CH_3CHO): One CH_3 group $\rightarrow$ slightly less reactive.
- Crotonaldehyde ($CH_3CH = CHCHO$): Conjugation with double bond $\rightarrow$ less reactive.
- Benzaldehyde (C_6H_5CHO): Conjugation with aromatic ring $\rightarrow$ strongly deactivated carbonyl carbon.

Step 3: Conclusion.
Formaldehyde is the most reactive aldehyde toward nucleophilic addition.

Final Answer:

$$\boxed{\text{Formaldehyde}}$$

Quick Tip

Less steric hindrance + stronger electrophilicity = greater reactivity in nucleophilic addition.

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19. Two isotonic solutions cannot have the same value of

(1) osmotic pressure
(2) density
(3) elevation in boiling point
(4) depression in freezing point

Correct Answer: (2) density
Solution: Step 1: Define isotonic solutions.
Two solutions are isotonic if they have the same osmotic pressure (π) at a given temperature.

Step 2: Colligative properties.
Osmotic pressure, elevation in boiling point, and depression in freezing point are colligative

properties — they depend only on the number of solute particles, not on their nature.

Step 3: Density check.
Density is not a colligative property; it depends on both the solute and solvent type. Thus, isotonic solutions may have different densities.

Final Answer:

$$\boxed{\text{density}}$$

Quick Tip

Isotonic = same osmotic pressure, but other properties like density can differ.

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20. An aromatic compound will

(A) have (4n+2) π electrons
(B) be conjugated
(C) be planar
(D) be cyclic

Choose the correct answer from the options given below:
(1) (A), (B) and (D) only
(2) (B), (C) and (D) only
(3) (A), (B), (C) and (D)
(4) (A), (B) and (C) only

Correct Answer: (3) (A), (B), (C) and (D)
Solution: Step 1: Recall Huckel's rule.
For aromaticity, a compound must have $(4n + 2)\pi$ electrons $(n = 0, 1, 2, ...)$.

Step 2: Structural requirements.
- Must be cyclic.
- Must be fully conjugated (p-orbitals overlap).
- Must be planar (allowing delocalization).

Step 3: Evaluate statements.
All four conditions (A, B, C, D) are required for aromaticity.

Final Answer:

$$\boxed{\text{(A), (B), (C) and (D)}}$$

Quick Tip

Aromatic compounds follow Huckel's rule: cyclic, planar, conjugated, with $(4n + 2)\pi$ electrons.

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21. SI unit of pressure is

(1) pascal
(2) atm
(3) torr
(4) newton

Correct Answer: (1) pascal
Solution: Step 1: Definition of pressure.
Pressure = Force per unit area.

$$P = \frac{F}{A}$$

Step 2: SI system units.
- Force (F) = Newton (N).
- Area (A) = m^2.
Thus,

$$1\,\text{Pa} = 1\,\frac{\text{N}}{m^2}.$$

Step 3: Other units.
- 1 atm = 1.013×10^5 Pa.
- 1 torr = $\frac{1}{760}$ atm.

Final Answer:

$$\boxed{\text{pascal}}$$

Quick Tip

Always remember: SI unit of pressure = Pascal = N/m^2.

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22. The statement "There is a plenty of room at the bottom" was given by

(1) Albert Einstein
(2) Isaac Newton
(3) Richard Feynman
(4) Linus Pauling

Correct Answer: (3) Richard Feynman
Solution: Step 1: Context of the statement.
The phrase *"There's Plenty of Room at the Bottom"* was a famous lecture delivered by Richard Feynman at the American Physical Society meeting at Caltech in 1959.

Step 2: Importance.
In this talk, Feynman envisioned the possibility of manipulating atoms and molecules directly — an idea that laid the foundation for modern nanotechnology.

Final Answer:

$$\boxed{\text{Richard Feynman}}$$

Quick Tip

Feynman's 1959 lecture is often credited as the origin of nanotechnology concepts.

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23. Which of the following is a top down approach for the synthesis of nanomaterials?

(1) Chemical vapour deposition
(2) Physical vapour deposition
(3) Ball Milling
(4) Sol gel process

Correct Answer: (3) Ball Milling
Solution: Step 1: Approaches in nanomaterial synthesis.
- **Top-down**: Start with bulk material and break it into smaller nanosized particles.
- **Bottom-up**: Build up nanostructures atom by atom or molecule by molecule.

Step 2: Classification of options.
- Chemical vapour deposition: bottom-up.
- Physical vapour deposition: bottom-up.
- Sol-gel process: bottom-up.
- Ball milling: mechanical grinding of bulk $\rightarrow$ nanosized particles (top-down).

Final Answer:

$$\boxed{\text{Ball Milling}}$$

Quick Tip

Top-down = breaking bulk material (e.g., ball milling); Bottom-up = building nanoparticles (e.g., sol-gel, CVD).

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24. Millikan's famous oil drop experiment established that

(1) Electric charge is quantized
(2) Mass is quantized
(3) Energy of an atom is quantized
(4) Workfunction is quantized

Correct Answer: (1) Electric charge is quantized
Solution: Step 1: Description of the experiment.
Millikan (1909) suspended tiny charged oil droplets between two electrically charged plates and observed their motion under gravity and an applied electric field.

Step 2: Key finding.
He found that the charge on each droplet was always an integer multiple of a smallest value:

$$q = n \times e, \quad e = 1.602 \times 10^{-19}\, C$$

Thus, establishing that electric charge is quantized.

Final Answer:

$$\boxed{\text{Electric charge is quantized}}$$

Quick Tip

Millikan's oil drop experiment measured the elementary charge e, proving charge quantization.

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25. Which of the following is not the unit of energy?

(1) Electron-volt
(2) Joule
(3) Newton-metre
(4) Pascal

Correct Answer: (4) Pascal
Solution: Step 1: Check each option.
- Electron-volt (eV): energy unit (1 eV = 1.602×10^{-19} J).
- Joule (J): SI unit of energy ($1\,J = 1\,N \cdot m$).
- Newton-metre (N·m): equivalent to Joule, hence energy unit.
- Pascal (Pa): unit of pressure ($1\,Pa = 1\,N/m^2$).

Step 2: Conclusion.
Therefore, Pascal is not a unit of energy.

Final Answer:

$$\boxed{\text{Pascal}}$$

Quick Tip

Energy units include Joule, eV, calorie, etc. Pressure unit = Pascal (Pa).

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26. An element naturally occurs in two isotopic forms. Which of the following statements is correct?

(1) Mass number of the two isotopes are same.
(2) Atomic number of the two isotopes are same.
(3) Number of nucleons are same.

(4) Number of neutrons are same.

Correct Answer: (2) Atomic number of the two isotopes are same.
Solution: Step 1: Definition of isotopes.
Isotopes are atoms of the same element that have the same atomic number (same protons) but different mass numbers (different neutrons).

Step 2: Analyze options.
- (1) Wrong: mass number differs in isotopes.
- (2) Correct: atomic number is identical (same element).
- (3) Wrong: nucleon number (mass number) differs.
- (4) Wrong: neutrons differ.

Final Answer:

$$\boxed{\text{Atomic number of the two isotopes are same}}$$

Quick Tip

Isotopes = same protons (Z), different neutrons → different mass numbers.

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27. The laws of reflection and refraction are true for all surfaces and pairs of media at the

(1) point of incidence
(2) point of refraction
(3) angle of incidence
(4) angle of reflection

Correct Answer: (1) point of incidence
Solution: Step 1: Recall the laws of reflection and refraction.
- Reflection: angle of incidence = angle of reflection.
- Refraction: Snell's law, $n_1 \sin i = n_2 \sin r$.

Step 2: Universality.
Both laws hold true regardless of surface shape or media, but they are defined precisely at the **point of incidence**, where the light ray meets the boundary.

Final Answer:

$$\boxed{\text{point of incidence}}$$

Quick Tip

Reflection and refraction laws apply at the point of incidence, independent of surface curvature or media.

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28. The dimensions of electrical conductivity is

(1) [TA]
(2) $[\mathrm{ML^3T^{-3}A^{-2}}]$
(3) $[\mathrm{M^{-1}L^{-3}T^3A^2}]$
(4) $[\mathrm{MLT^{-3}A^{-1}}]$

Correct Answer: (3) $[\mathrm{M^{-1}L^{-3}T^3A^2}]$
Solution: Step 1: Relation between conductivity and resistivity.
Conductivity (σ) is reciprocal of resistivity (ρ):

$$\sigma = \frac{1}{\rho}$$

Step 2: Dimensions of resistivity.
Resistivity:

$$\rho = R \cdot \frac{A}{L}$$

where resistance $R = \frac{V}{I}$.
Voltage (V) has dimensions:

$$[V] = [ML^2T^{-3}A^{-1}]$$

Current (I) = [A]. So,

$$[R] = [ML^2T^{-3}A^{-2}]$$

Now,

$$[\rho] = [R] \cdot \frac{L^2}{L} = [ML^3T^{-3}A^{-2}]$$

Step 3: Conductivity.

$$[\sigma] = [\rho]^{-1} = [M^{-1}L^{-3}T^3A^2]$$

Final Answer:

$$\boxed{[M^{-1}L^{-3}T^3A^2]}$$

Quick Tip

Conductivity = reciprocal of resistivity, so flip the dimensions of ρ.

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29. For the given carbon resistor, the resistance is $2.4 \times 10^6\,\Omega$. The sequence of colours in the strips provided on resistor is

(1) red, yellow and green
(2) red, yellow and blue
(3) brown, orange and green
(4) red, green and yellow

Correct Answer: (2) red, yellow and blue

Solution: Step 1: Recall resistor colour code.
Digits: black–0, brown–1, red–2, orange–3, yellow–4, green–5, blue–6, violet–7, grey–8, white–9.

Step 2: Apply to given resistance.
Value: $2.4 \times 10^6\,\Omega$.
- First digit (2) $\rightarrow$ red.
- Second digit (4) $\rightarrow$ yellow.
- Multiplier (10^6) $\rightarrow$ blue (6).
So, colour code = red, yellow, blue.

Final Answer:

$$\boxed{\text{red, yellow and blue}}$$

Quick Tip

Resistor colour code = first two digits + multiplier. Example: $2.4 \times 10^6\,\Omega \Rightarrow$ red–yellow–blue.

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30. The packing fraction of a crystal structure is 74%. The crystal structure is

(1) Simple cubic structure
(2) Face-centred cubic structure
(3) Body-centred cubic structure
(4) Crystal structure of Tungsten

Correct Answer: (2) Face-centred cubic structure
Solution: Step 1: Recall packing fractions.
- Simple cubic (SC): 52.4%.
- Body-centred cubic (BCC): 68.0%.
- Face-centred cubic (FCC): 74.0%.

Step 2: Identify correct structure.
Given 74% matches FCC (also called cubic close packing, CCP).

Final Answer:

$$\boxed{\text{Face-centred cubic structure}}$$

Quick Tip

Packing efficiency: SC (52%), BCC (68%), FCC/CCP (74%), HCP (74%).

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31. An s-orbital may combine with p-orbital provided that lobes of p-orbital are

(1) perpendicular to the axis joining the nuclei
(2) pointing along the axis joining the nuclei

(3) making an acute angle with the axis joining the nuclei
(4) making an obtuse angle with the axis joining the nuclei

Correct Answer: (2) pointing along the axis joining the nuclei
Solution: Step 1: Recall orbital overlap condition.
Effective overlap occurs when orbitals are aligned along the internuclear axis (the line joining two nuclei).

Step 2: Application to s and p orbitals.
- The spherical s-orbital can overlap with a p-orbital lobe only if the lobe points along the axis joining the nuclei.
- If perpendicular, acute, or obtuse angle → poor or zero overlap.

Final Answer:

$$\boxed{\text{pointing along the axis joining the nuclei}}$$

Quick Tip

Maximum overlap = stronger bond. For s–p overlap, the p orbital lobe must point along the bond axis.

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32. Lyman spectral series is found in region of spectrum

(1) Ultraviolet
(2) Visible
(3) Infra red
(4) Microwave

Correct Answer: (1) Ultraviolet
Solution: Step 1: Recall hydrogen spectral series.
- Lyman series: transitions to $n = 1$, energy gap large → ultraviolet.
- Balmer series: transitions to $n = 2$ → visible.
- Paschen, Brackett, Pfund: transitions to $n = 3, 4, 5$ → infrared.

Step 2: Conclusion.
Thus, the Lyman series lies in the ultraviolet region.

Final Answer:

$$\boxed{\text{Ultraviolet}}$$

Quick Tip

Mnemonic: Lyman = UV, Balmer = Visible, Paschen+ = Infrared.

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33. Newton's laws of classical mechanics are replaced in quantum mechanics by.....

(1) Snell's Law
(2) Schrödinger's equations
(3) Maxwell's equations
(4) Laplace equation

Correct Answer: (2) Schrödinger's equations
Solution: Step 1: Classical vs quantum mechanics.
- Newton's laws describe motion of macroscopic objects.
- At atomic scale, particles show wave–particle duality, making Newton's framework invalid.

Step 2: Quantum framework.
The time-dependent Schrödinger equation:

$$i\hbar\frac{\partial\Psi}{\partial t} = \hat{H}\Psi$$

describes how the wavefunction Ψ evolves in time.

Step 3: Conclusion.
Thus, Newton's laws are replaced in quantum mechanics by Schrödinger's equations.

Final Answer:

$$\boxed{\text{Schrödinger's equations}}$$

Quick Tip

Newton → Classical motion; Schrödinger → Quantum motion (wavefunctions, probabilities).

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34. Principal Quantum number represents

(1) Quantization of angular momentum magnitude
(2) Quantization of angular momentum direction
(3) Quantization of energy
(4) Space quantization

Correct Answer: (3) Quantization of energy
Solution: Step 1: Recall the meaning of principal quantum number (n).
The principal quantum number specifies the main energy level (shell) of an electron in an atom. It determines the size of the orbital and the energy of the electron.
Step 2: Check the options.
- (1) Magnitude of angular momentum depends on the azimuthal quantum number (l), not n.
- (2) Direction of angular momentum is given by the magnetic quantum number (m_l).
- (3) Correct — energy is quantized and directly related to n.
- (4) Space quantization is associated with m_l.

Final Answer:

$$\boxed{\text{Quantization of energy}}$$

Quick Tip

Principal quantum number (n) = shell number; higher $n \Rightarrow$ higher energy and larger orbital.

---

35. Which of the following is incorrect as per rules for Linear Combination of Atomic Orbitals (LCAO)?

(1) The atomic orbitals overlap as much as possible
(2) Overlap of orbitals has to be as low as possible
(3) The atomic orbitals should be of same energy
(4) Symmetry of two atomic orbitals must remain unchanged or both change symmetry in the same manner

Correct Answer: (2) Overlap of orbitals has to be as low as possible
Solution: Step 1: LCAO principle.
Molecular orbitals are formed by linear combinations of atomic orbitals. For effective bonding:
- The overlap must be maximum (to increase electron density between nuclei).
- Orbitals must have the same or nearly same energy.
- Symmetry of combining orbitals must be compatible.

Step 2: Incorrect statement.
Statement (2) contradicts the rule because greater overlap leads to stronger bonds, not lower overlap.

Final Answer:

$$\boxed{\text{Overlap of orbitals has to be as low as possible}}$$

Quick Tip

Maximum overlap $\rightarrow$ stronger bond. LCAO requires same energy, proper symmetry, and large overlap.

---

36. If an element of high electronegativity combines with an electropositive metal then the product will be

(1) an interstitial alloy
(2) an ionic compound
(3) a substitutional alloy
(4) a simple mixture

Correct Answer: (2) an ionic compound
Solution: Step 1: Recall electronegativity concept.
- A highly electronegative element (e.g., Cl, O) tends to gain electrons.

- An electropositive metal (e.g., Na, K, Ca) tends to lose electrons.

Step 2: Bond formed.
The electron transfer leads to the formation of cations (from metal) and anions (from non-metal), producing an **ionic compound**.

Step 3: Eliminate other options.
- Interstitial alloy: small atoms occupy voids in metal lattice (not the case here).
- Substitutional alloy: one metal substitutes another in a lattice (metal-metal combination).
- Simple mixture: no chemical bonding.

Final Answer:

$$\boxed{\text{an ionic compound}}$$

Quick Tip

High χ element + electropositive metal $\rightarrow$ ionic bonding via electron transfer.

---

37. Acetophenone and Benzaldehyde can be distinguished by:

(A) Tollen's reagent
(B) DNP test
(C) Iodoform test
(D) Carbylamine test

Choose the correct answer from the options given below:
(1) (A), (B) and (D) only
(2) (A) and (C) only
(3) (A) and (B) only
(4) (B) and (D) only

Correct Answer: (2) (A) and (C) only
Solution: Step 1: Recall the tests.
- **Tollens' test:** Benzaldehyde (an aldehyde) gives a silver mirror; acetophenone (a ketone) does not.
- **DNP test:** Both aldehydes and ketones give positive 2,4-DNP test (orange/yellow ppt), so not distinguishing.
- **Iodoform test:** Acetophenone (methyl ketone) gives yellow ppt of CHI_3; benzaldehyde does not.
- **Carbylamine test:** Detects primary amines, not aldehydes/ketones.

Step 2: Conclusion.
Thus, acetophenone and benzaldehyde can be distinguished by Tollens reagent and Iodoform test.

Final Answer:

(A) and (C) only

Quick Tip

Tollens' reagent distinguishes aldehyde vs ketone; Iodoform test distinguishes methyl ketones.

---

38. Explanation for occurrence of monovalency in Group 13 is given by.....

(1) Pauli's Exclusion Principle
(2) Hund's Rule
(3) Inert Pair effect
(4) Isotope effect

Correct Answer: (3) Inert Pair effect
Solution: Step 1: Recall Group 13 elements.
Group 13 (B, Al, Ga, In, Tl) usually show +3 oxidation state.

Step 2: Inert pair effect.
In heavier elements (like Tl), the ns^2 electrons become reluctant to participate in bonding due to poor shielding and relativistic effects. This causes a stable +1 oxidation state (monovalency).

Step 3: Conclusion.
Thus, the occurrence of monovalency in Group 13 is explained by the inert pair effect.

Final Answer:

Inert Pair effect

Quick Tip

Inert pair effect: reluctance of ns^2 electrons to bond $\rightarrow$ stable lower oxidation states in heavier p-block elements.

---

39. Which of the following is an example of electromagnetic waves?

(1) Alpha rays
(2) Beta plus rays
(3) Beta minus rays
(4) Gamma rays

Correct Answer: (4) Gamma rays
Solution: Step 1: Recall the types of radiation.
- **Alpha rays** (α): Helium nuclei ($_2^4He^{2+}$), which are charged particles. - **Beta rays** (β):

Electrons (β^-) or positrons (β^+), which are also charged particles. - **Gamma rays** (γ): High-energy photons, which are electromagnetic waves.

Step 2: Conclusion.
Gamma rays are the only electromagnetic waves among the given options. They are part of the electromagnetic spectrum, unlike alpha and beta rays, which are particles.

Final Answer:

$$\boxed{\text{Gamma rays}}$$

Quick Tip

Electromagnetic radiation includes gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves, and radio waves.

---

40. Which of the following properties is not observed in the case of Superconductors?
(1) Meissner Effect
(2) Formation of Cooper pairs
(3) Paramagnetism
(4) Zero resistivity

Correct Answer: (3) Paramagnetism
Solution: Step 1: Superconductivity properties.
Superconductors exhibit several unique behaviors when cooled below their critical temperature: - **Meissner Effect**: Expulsion of magnetic fields from a superconductor. - **Formation of Cooper pairs**: Electrons pair up with opposite spin and momentum, enabling superconductivity. - **Zero resistivity**: Complete absence of electrical resistance.
Step 2: Paramagnetism.
- **Paramagnetism**: Materials that are weakly attracted by an external magnetic field, which is not a property of superconductors. Instead, superconductors are characterized by perfect diamagnetism (expelling the magnetic field).

Final Answer:

$$\boxed{\text{Paramagnetism}}$$

Quick Tip

Superconductors exhibit perfect diamagnetism, not paramagnetism. The Meissner Effect is key!

---

41. Newton's law of cooling is a special case of

(1) Wien's displacement law
(2) Kirchhoff's law

(3) Stefan's law
(4) Planck's law

Correct Answer: (3) Stefan's law
Solution: Step 1: Newton's Law of Cooling.
Newton's law of cooling states that the rate of change of temperature of an object is proportional to the difference between the object's temperature and the ambient temperature.

Step 2: Stefan's Law.
Stefan-Boltzmann law describes how the energy radiated by a black body is proportional to the fourth power of its temperature (T^4). The cooling of an object due to radiation can be modeled by this law in the context of temperature difference between the body and its surroundings.

Step 3: Conclusion.
Thus, Newton's law of cooling is essentially a special case of Stefan's law where the temperature difference is small and the radiation is in the linear regime.

Final Answer:

$$\boxed{\text{Stefan's law}}$$

Quick Tip

Newton's law of cooling deals with heat loss by radiation, which is governed by Stefan-Boltzmann's law.

---

42. The centre of negative charge distribution in a molecule may or may not coincide with the centre of the positive charge distribution. If it does not coincide, each molecule has a permanent dipole moment. Such materials are called

(1) polar materials
(2) non-polar materials
(3) ionic materials
(4) covalent bonded materials

Correct Answer: (1) polar materials
Solution: Step 1: Definition of a dipole moment.
A dipole moment arises when there is a separation of positive and negative charge centers in a molecule.

Step 2: Polar vs Non-polar.
- **Polar materials** have a permanent dipole moment due to asymmetric charge distribution (e.g., H_2O).
- **Non-polar materials** have no permanent dipole moment, where the centers of positive and negative charges coincide (e.g., O_2).

Step 3: Conclusion.
Molecules with a permanent dipole moment are called **polar materials**.

Final Answer:

$$\boxed{\text{polar materials}}$$

Quick Tip

Polar materials = molecules with a permanent dipole moment due to an uneven distribution of charges.

---

43. A dielectric slab is inserted between the plates of an isolated capacitor. The force between the plates will

(1) increase
(2) remain unchanged
(3) decrease
(4) become zero

Correct Answer: (3) decrease
Solution: Step 1: Recall the effect of a dielectric.
When a dielectric material is inserted between the plates of a capacitor, it increases the capacitance by a factor of the dielectric constant (κ). For an isolated capacitor, the charge Q remains constant.

Step 2: Force between the plates.
The force F between the plates of a capacitor is given by:

$$F = \frac{1}{2}\frac{Q^2}{A\epsilon_0}\left(\frac{1}{d^2}\right)$$

When a dielectric is inserted, the electric field between the plates decreases, thus reducing the force between the plates.
Step 3: Conclusion.
Thus, the force between the plates will decrease.

Final Answer:

$$\boxed{\text{decrease}}$$

Quick Tip

Inserting a dielectric increases capacitance but decreases the force between the plates, as the electric field is reduced.

---

44. If no thermal energy is developed as the charge goes through the battery, then such a battery is called

(1) an ideal battery
(2) an ideal dielectric
(3) an ideal capacitor
(4) an ideal resistor

Correct Answer: (1) an ideal battery
Solution: Step 1: Definition of an ideal battery.
An ideal battery is one that provides a constant potential difference (voltage) without any internal resistance. No energy is lost as heat, so no thermal energy is developed when charge flows through it.

Step 2: Analyze the options.
- Ideal dielectric: a material that doesn't conduct charge.
- Ideal capacitor: a perfect capacitor with no losses or imperfections.
- Ideal resistor: a resistor with no internal heat dissipation (not possible in real life).

Step 3: Conclusion.
The battery that does not develop any thermal energy when charge flows through it is called an **ideal battery**.

Final Answer:

an ideal battery

Quick Tip

An ideal battery delivers power without any loss as heat. It has no internal resistance.

---

45. In a discharge tube electric conduction does not occur due to the movement of

(1) positive ions
(2) negative ions
(3) electrons
(4) protons

Correct Answer: (4) protons
Solution: Step 1: Recall conduction in discharge tubes.
In a discharge tube, electrical conduction primarily occurs due to the movement of free electrons. These electrons are accelerated by an applied electric field and cause ionization of the gas, creating further conduction.

Step 2: Analyze the options.
- Positive ions (cations) and negative ions (anions) contribute to current but are not the main carriers of conduction in a discharge tube.
- Electrons (e^-) are the primary carriers of electrical current in discharge tubes.
- Protons do not typically participate in conduction in discharge tubes as they are not free to

move.

Step 3: Conclusion.
Protons do not contribute to electrical conduction in discharge tubes.

Final Answer:

$$\boxed{\text{protons}}$$

Quick Tip

In discharge tubes, electrons are the primary carriers of electrical conduction.

---

46. Arrange the following in the order of increasing acidic strength

(A) HCl
(B) HBr
(C) HI
(D) HF

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (D), (A), (B), (C).
(3) (B), (A), (D), (C).
(4) (C), (B), (A), (D).

Correct Answer: (4) (C), (B), (A), (D).
Solution: Step 1: Acidic strength of hydrohalic acids.
Acidic strength of hydrogen halides increases as the bond strength between H and the halogen decreases. The weaker the bond, the easier it is for the hydrogen ion to dissociate, increasing acidic strength.

Step 2: Bond dissociation.
- HF has a very strong H-F bond, making it the weakest acid.
- HCl, HBr, and HI have progressively weaker bonds.

Step 3: Conclusion.
The order of increasing acidic strength is:

$$\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$$

Final Answer:

$$\boxed{\text{(C), (B), (A), (D)}}$$

Quick Tip

Acidic strength increases with decreasing bond strength between hydrogen and the halogen.

47. Arrange the following in the order of increasing wavelength
(A) Lyman
(B) Balmer
(C) Paschen
(D) Brackett

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (D), (C), (B), (A).
(3) (B), (A), (D), (C).
(4) (C), (B), (D), (A).

Correct Answer: (2) (D), (C), (B), (A).
Solution: Step 1: Recall the regions of the hydrogen spectral series.
- Lyman series: UV (shortest wavelength, highest energy).
- Balmer series: Visible light.
- Paschen series: Infrared.
- Brackett series: Infrared (longer wavelength than Paschen).

Step 2: Increasing wavelength order.
The order of increasing wavelength corresponds to increasing energy levels in the electron transitions. Longer wavelengths correspond to transitions that occur from lower energy levels.

Step 3: Conclusion.
Thus, the order of increasing wavelength is:

$$\text{Lyman} < \text{Balmer} < \text{Paschen} < \text{Brackett}$$

Final Answer:

$$\boxed{\text{(D), (C), (B), (A)}}$$

Quick Tip

Series order: Lyman (UV), Balmer (Visible), Paschen and Brackett (Infrared), with increasing wavelength.

---

48. Arrange the following metals in the order of increasing work function
(A) Potassium (K)
(B) Cesium (Cs)
(C) Platinum (Pt)
(D) Calcium (Ca)

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (B), (A), (D), (C).

(3) (B), (A), (C), (D).
(4) (C), (D), (A), (B).

Correct Answer: (3) (B), (A), (C), (D).
Solution: Step 1: Recall work function.
The work function (ϕ) is the minimum energy needed to remove an electron from the surface of a metal. It depends on the metal's electron affinity. Metals with a low ionization energy have a low work function, while metals with higher ionization energies have higher work functions.

Step 2: Compare the metals.
- **Cesium (Cs)** has the lowest work function due to its low ionization energy (alkali metal).
- **Potassium (K)** also has a low work function, but higher than Cs.
- **Calcium (Ca)** is an alkaline earth metal and has a higher work function than alkali metals.
- **Platinum (Pt)**, a noble metal, has the highest work function due to its stable, tightly bound electrons.

Step 3: Conclusion.
Thus, the order of increasing work function is:

$$\text{Cs} < \text{K} < \text{Ca} < \text{Pt}$$

Final Answer:

$$\boxed{\text{(B), (A), (C), (D)}}$$

Quick Tip

Work function increases with metal's ionization energy and decreases with atomic size. Alkali metals have the lowest work functions.

---

49. Arrange the following in the order of increasing first ionization energy
(A) Beryllium (Be)
(B) Boron (B)
(C) Lithium (Li)
(D) Carbon (C)

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (C), (B), (A), (D).
(3) (B), (A), (D), (C).
(4) (D), (B), (A), (C).

Correct Answer: (2) (C), (B), (A), (D).
Solution: Step 1: Ionization energy trend.
Ionization energy increases across a period (from left to right) because the atomic size decreases, leading to a stronger attraction between the nucleus and the electrons. Ionization energy decreases down a group because the outermost electrons are farther from the nucleus and more

shielded by inner electrons.

Step 2: Analyze the elements.
- **Lithium (Li)** has the lowest ionization energy because it is in Group 1.
- **Boron (B)** has a higher ionization energy than Li but less than Be and C.
- **Beryllium (Be)** has a higher ionization energy due to its stable s^2 electron configuration.
- **Carbon (C)** has the highest ionization energy because it is farther across the period and has a relatively small atomic size.

Step 3: Conclusion.
The order of increasing first ionization energy is:

$$\text{Li} < \text{B} < \text{Be} < \text{C}$$

Final Answer:

$$\boxed{\text{(C), (B), (A), (D)}}$$

Quick Tip

Ionization energy increases across a period and decreases down a group.

---

50. Arrange the following components in the order of their function in power supply

(A) Voltage regulator
(B) Rectifier
(C) Transformer
(D) Filter

Choose the correct answer from the options given below:
(1) (B), (A), (C), (D).
(2) (A), (B), (C), (D).
(3) (B), (A), (D), (C).
(4) (C), (B), (D), (A).

Correct Answer: (4) (C), (B), (D), (A).
Solution: Step 1: Understand the sequence of operations in a power supply.
1. **Transformer (C)**: First step in converting AC voltage, stepping it up or down.
2. **Rectifier (B)**: Converts AC to DC by using diodes to rectify the AC signal.
3. **Filter (D)**: Smoothens the rectified DC voltage by reducing fluctuations.
4. **Voltage regulator (A)**: Maintains a constant DC voltage, even if the input voltage varies.

Step 2: Conclusion.
The correct order of operation is:

$$\text{Transformer} \rightarrow \text{Rectifier} \rightarrow \text{Filter} \rightarrow \text{Voltage Regulator}$$

Final Answer:

$$\boxed{\text{(C), (B), (D), (A)}}$$

Quick Tip

In a power supply, the sequence is: Transformer → Rectifier → Filter → Voltage Regulator.

---

51. Arrange the following events in an increasing order (calendar year)

(A) Nobel Prize in Physics for Photoelectric Effect
(B) Nobel Prize in Chemistry for Quantum Dots synthesis and Applications
(C) Nobel Prize for the invention of Scanning Tunneling Electron Microscope
(D) Nobel Prize to Max Planck for his Quantum Theory

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (A), (D), (C), (B).
(3) (D), (A), (C), (B).
(4) (C), (B), (D), (A).

Correct Answer: (3) (D), (A), (C), (B).
Solution: Step 1: Date of Nobel Prizes.
- **Max Planck** received the Nobel Prize in Physics in 1918 for his quantum theory.
- **Albert Einstein** won the Nobel Prize in Physics in 1921 for the **Photoelectric Effect**.
- **Gerd Binnig and Heinrich Rohrer** won the Nobel Prize in Physics in 1986 for the invention of the **Scanning Tunneling Electron Microscope**.
- **Nobel Prize in Chemistry for Quantum Dots** synthesis and applications was awarded to **Alivisatos, Brus, and Moroz** in **2022**.

Step 2: Conclusion.
The increasing order of events (in terms of calendar years) is:

$$\text{Max Planck (D)} \rightarrow \text{Einstein (A)} \rightarrow \text{Binnig and Rohrer (C)} \rightarrow \text{Quantum Dots (B)}$$

Final Answer:

$$\boxed{\text{(D), (A), (C), (B)}}$$

Quick Tip

The Nobel Prize timeline: Planck (1918) → Einstein (1921) → Binnig/Rohrer (1986) → Quantum Dots (2022).

---

52. Arrange the following nanomaterials in the order of increasing degree of freedom

(A) Bulk material
(B) Graphene Sheet
(C) Quantum Dot
(D) Carbon Nanotubes

Choose the correct answer from the options given below:
(1) (C), (D), (B), (A).
(2) (A), (B), (C), (D).
(3) (B), (A), (D), (C).
(4) (C), (B), (D), (A).

Correct Answer: (1) (C), (D), (B), (A).
Solution: Step 1: Understand the degree of freedom.
- **Bulk material**: Has the least degree of freedom since it has continuous translational, vibrational, and rotational freedom at the macroscopic level.
- **Graphene sheet**: Free to move in two dimensions (2D) but constrained in one.
- **Carbon Nanotubes**: Have both translational freedom and some unique properties in 1D, offering higher freedom than graphene.
- **Quantum Dots**: These are confined in all three dimensions, restricting the movement of electrons, which gives them the highest degree of freedom in terms of quantum mechanics.

Step 2: Conclusion.
Thus, the order of increasing degree of freedom is:

$$\text{Quantum Dot (C)} < \text{Carbon Nanotubes (D)} < \text{Graphene Sheet (B)} < \text{Bulk Material (A)}$$

Final Answer:

$$\boxed{\text{(C), (D), (B), (A)}}$$

Quick Tip

Quantum dots have the highest confinement (3D), while bulk materials have the least (unconstrained).

---

53. Which of the following exists as a covalent crystal in the solid state?

(A) Sulphur
(B) Iodine
(C) Phosphorus
(D) Silicon

Choose the correct answer from the options given below:
(1) (A) and (C) only
(2) (D) only
(3) (B) and (D) only

(4) (A), (B) and (C) only

Correct Answer: (2) (D) only
Solution: Step 1: Understand types of solids.
- **Covalent crystals**: Atoms are held together by covalent bonds, resulting in a very strong structure.
- **Silicon (D)**: Forms a covalent crystal structure (diamond-like).
- **Sulphur (A)**: Exists as S_8 molecules in a molecular solid, not a covalent crystal.
- **Iodine (B)**: Exists as I_2 molecules in a molecular solid.
- **Phosphorus (C)**: Exists in molecular form (white phosphorus), not as a covalent crystal.

Step 2: Conclusion.
Thus, only Silicon (D) forms a covalent crystal.

Final Answer:

$$\boxed{\text{(D) only}}$$

Quick Tip

Covalent crystals = diamond-like structure (e.g., Silicon). Molecular solids (e.g., Iodine, Sulphur) are not covalent crystals.

---

54. Arrange the following electron acceptors of Z-scheme of photosynthesis based on the movement of electron from P680 onwards.

(A) Iron-Sulphur Proteins
(B) Ferrodoxin
(C) Plastocyanin
(D) Plastoquinones

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (D), (C), (B), (A).
(3) (D), (A), (B), (C).
(4) (D), (C), (A), (B).

Correct Answer: (4) (D), (C), (A), (B).
Solution: Step 1: Understanding the Z-scheme of photosynthesis.
The Z-scheme is a representation of the electron flow in photosynthesis. Electrons are excited in P680 (Photosystem II) and passed along a series of electron acceptors:

$$P680 \rightarrow \text{Plastoquinones} \rightarrow \text{Plastocyanin} \rightarrow \text{Iron-Sulphur Proteins} \rightarrow \text{Ferrodoxin}$$

Step 2: Analyze the order.
- **Plastoquinones (D)** are the first electron acceptors after P680.
- **Plastocyanin (C)** accepts electrons next.

- **Iron-Sulphur Proteins (A)** are part of the electron transport chain after Plastocyanin.
- **Ferrodoxin (B)** is the final electron acceptor in the process.

Step 3: Conclusion.
The correct order based on electron movement is:

$$\text{Plastoquinones} \rightarrow \text{Plastocyanin} \rightarrow \text{Iron-Sulphur Proteins} \rightarrow \text{Ferrodoxin}$$

Final Answer:

$$\boxed{\text{(D), (C), (A), (B)}}$$

Quick Tip

In the Z-scheme, electrons flow from P680 to plastoquinones, plastocyanin, iron-sulphur proteins, and finally to ferrodoxin.

---

55. Arrange the following electron acceptors of Z-scheme of photosynthesis based on the movement of electron from P680 onwards.

(A) Iron-Sulphur Proteins
(B) Ferrodoxin
(C) Plastocyanin
(D) Plastoquinones

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (D), (C), (B), (A).
(3) (D), (A), (B), (C).
(4) (D), (C), (A), (B).

Correct Answer: (4) (D), (C), (A), (B).
Solution: Step 1: Understand the Z-scheme of photosynthesis.
The Z-scheme is the electron transport chain of photosynthesis. The electron flow starts with the excitation of electrons in P680 (Photosystem II), and the sequence of electron acceptors is as follows:

$$P680 \rightarrow \text{Plastoquinones} \rightarrow \text{Plastocyanin} \rightarrow \text{Iron-Sulphur Proteins} \rightarrow \text{Ferrodoxin}$$

Step 2: Conclusion.
Thus, the correct order is:

$$\text{Plastoquinones} \rightarrow \text{Plastocyanin} \rightarrow \text{Iron-Sulphur Proteins} \rightarrow \text{Ferrodoxin}$$

Final Answer:

$$\boxed{\text{(D), (C), (A), (B)}}$$

Quick Tip

In the Z-scheme, electrons flow in the order: P680 → Plastoquinones → Plastocyanin → Iron-Sulphur Proteins → Ferrodoxin.

---

56. Arrange the following events in an order that explains the bulk flow of substances in the phloem from the source.

(A) Water diffuses into the sieve tube elements
(B) Leaf cells produce sugar by photosynthesis
(C) Solutes are actively transported into sieve elements
(D) Sugar is transported from cell to cell via the apoplast and/or symplast

Choose the correct answer from the options given below:
(1) (A), (B), (C), (D).
(2) (B), (D), (C), (A).
(3) (B), (A), (D), (C).
(4) (C), (B), (D), (A).

Correct Answer: (2) (B), (D), (C), (A).
Solution: Step 1: Understand the bulk flow process in phloem.
Phloem transport occurs via a process called bulk flow, where sugars are produced in the leaves and transported to other parts of the plant.
Step 2: Sequence of events.
1. **Leaf cells produce sugar by photosynthesis (B)**: Photosynthesis generates sugars in the leaves, which is the source of phloem transport.
2. **Sugar is transported from cell to cell via the apoplast and/or symplast (D)**: The sugars move through the plant from cell to cell.
3. **Solutes are actively transported into sieve elements (C)**: Sugars are actively loaded into the sieve tube elements from the surrounding cells.
4. **Water diffuses into the sieve tube elements (A)**: Water enters the sieve tubes to balance the osmotic potential created by the sugar influx.

Step 3: Conclusion. Thus, the correct order is:

$$B \rightarrow D \rightarrow C \rightarrow A$$

Final Answer:

$$\boxed{\text{(B), (D), (C), (A)}}$$

Quick Tip

Phloem transport: Sugars made in leaves move through symplast/apoplast → sieve tubes → water enters.

---

57. Ionic compounds are

(A) Made up of positive and negative ions and attraction between ions is electrostatic
(B) Ionic bonds are non-directional
(C) Melting point and boiling point are usually low
(D) Usually soft

Choose the correct answer from the options given below:
(1) (A) and (D) only
(2) (A), (B) and (C) only
(3) (A) only
(4) (A) and (B) only

Correct Answer: (2) (A), (B) and (C) only
Solution: Step 1: Ionic compounds characteristics.
- **(A) Made up of positive and negative ions**: Correct. Ionic compounds consist of ions held together by electrostatic forces.
- **(B) Ionic bonds are non-directional**: Correct. The electrostatic attraction in ionic bonds is non-directional, meaning the attraction is the same in all directions.
- **(C) Melting point and boiling point are usually low**: Incorrect. Ionic compounds typically have high melting and boiling points due to the strong electrostatic forces between ions.
- **(D) Usually soft**: Incorrect. Ionic compounds are usually hard, not soft, because of the strong ionic bonds.

Step 2: Conclusion. The correct options are (A), (B), and (C).

Final Answer:

$$\boxed{\text{(A), (B) and (C) only}}$$

Quick Tip

Ionic compounds = high melting points and hard but brittle; bonds are non-directional.

---

58. Which of the following are three-terminal devices?

(A) Zener diode
(B) Photodiode
(C) Bipolar Junction Transistor
(D) Field Effect Transistor

Choose the correct answer from the options given below:
(1) (A), (B) and (D) only.
(2) (A), (B) and (C) only.
(3) (C) and (D) only.
(4) (B) and (D) only.

Correct Answer: (3) (C) and (D) only.
Solution: Step 1: Define three-terminal devices.
- A **three-terminal device** has three terminals: one for input, one for output, and one for control.
- **Zener diode** and **photodiode** are two-terminal devices.
- **Bipolar Junction Transistor (BJT)** and **Field Effect Transistor (FET)** are both three-terminal devices. The three terminals are the collector, base, and emitter for BJTs, and the source, gate, and drain for FETs.

Step 2: Conclusion.
Thus, the three-terminal devices are **BJT (C)** and **FET (D)**.

Final Answer:

$$\boxed{\text{(C) and (D) only}}$$

Quick Tip

BJTs and FETs are three-terminal devices; diodes (Zener and photodiode) are two-terminal devices.

---

59. When the elements react to form compounds, a negative free energy change (ΔG) means

(A) Spontaneous reaction
(B) Free energy of the products is higher than that of reactants
(C) Very high activation barrier
(D) Exergonic reactions

Choose the correct answer from the options given below:
(1) (A), (B) and (D) only.
(2) (A), (B) and (C) only.
(3) (A), (B), (C) and (D).
(4) (A) and (D) only.

Correct Answer: (4) (A) and (D) only.
Solution: Step 1: Free energy change (ΔG) in reactions.
- **Negative ΔG** indicates that the reaction is **spontaneous** and can proceed without external energy input.
- **Spontaneous reaction**: The reaction will proceed in the direction where the free energy decreases.
- **Exergonic reactions**: These are reactions that release energy, corresponding to a negative ΔG.
- **Option (B)** is incorrect because negative ΔG indicates the free energy of the products is lower than the reactants, not higher.
- **Option (C)**: While high activation energy can exist in some spontaneous reactions, it is

not required for a negative ΔG.

Step 2: Conclusion. Thus, the correct options are **spontaneous reaction** and **exergonic reactions**.

Final Answer:

$$\boxed{\text{(A) and (D) only}}$$

Quick Tip

A negative ΔG indicates a spontaneous, exergonic reaction where energy is released.

---

60. On descending the group from Li to Na to K to Rb to Cs

(A) Metallic radius increases
(B) Melting point and boiling point decrease
(C) Density decreases
(D) Ionization energy decreases

Choose the correct answer from the options given below:
(1) (A) and (B) only.
(2) (B) and (C) only.
(3) (A), (B) and (D) only.
(4) (A), (C) and (D) only.

Correct Answer: (3) (A), (B) and (D) only.
Solution: Step 1: Analyze periodic trends.
- **Metallic radius increases** as we go down the group because the atoms get larger due to the addition of electron shells.
- **Melting point and boiling point decrease** as we move down the group because the metallic bonds weaken due to increased atomic size.
- **Density increases**, not decreases, as you go down the group because the atoms get larger and more massive.
- **Ionization energy decreases** as we move down the group because the outermost electron is farther from the nucleus and more shielded by inner electrons.

Step 2: Conclusion. Thus, the correct options are **(A)**, **(B)**, and **(D)**.

Final Answer:

$$\boxed{\text{(A), (B) and (D) only}}$$

Quick Tip

As you go down Group 1 (alkali metals): metallic radius increases, ionization energy decreases, and melting/boiling points generally decrease.

---

61. In Cubic lattice,

(A) For face centered cubic (fcc) lattice, effective number of atoms per unit cell is 2
(B) For body centered cubic (bcc) lattice, effective number of atoms per unit cell is 4
(C) $a = b = c$, and $\alpha = \beta = \gamma = 90^\circ$, where a, b, c are edge lengths and α, β, γ are axial angles
(D) For simple cubic (sc) lattice, effective number of atoms per unit cell is 1

Choose the correct answer from the options given below:
(1) (A), (B) and (D) only.
(2) (A), (B) and (C) only.
(3) (C) and (D) only.
(4) (B), (C) and (D) only.

Correct Answer: (1) (A), (B) and (D) only.
Solution: Step 1: Face-Centered Cubic (FCC).
- In FCC, atoms are located at the corners and centers of the faces of the unit cell.
- The effective number of atoms per unit cell is 4 (not 2).

Step 2: Body-Centered Cubic (BCC).
- In BCC, there is one atom at each corner and one at the center of the unit cell.
- The effective number of atoms per unit cell is 2, not 4.

Step 3: Simple Cubic (SC).
- In SC, there is one atom at each corner of the unit cell.
- The effective number of atoms per unit cell is 1.

Step 4: Conclusion. Thus, the correct answers are:

(A), (B), (D) only

Final Answer:

$$\boxed{\text{(A), (B) and (D) only}}$$

Quick Tip

FCC has 4 atoms per unit cell, BCC has 2, and SC has 1. All cubic unit cells have $a = b = c$ and $\alpha = \beta = \gamma = 90^\circ$.

---

62. Which of the following are correct statements?

(A) Hydrogen bond is weaker than covalent bond.
(B) CH_4 has covalent bonds.
(C) Covalent compounds do not conduct electricity except diamond.
(D) Graphite is a soft solid and a good conductor of electricity.

Choose the correct answer from the options given below:

(1) (A), (B) and (D) only.
(2) (A), (B) and (C) only.
(3) (A), (B), (C) and (D).
(4) (B), (C) and (D) only.

Correct Answer: (1) (A), (B) and (D) only.
Solution: Step 1: Hydrogen Bonding.
- **Hydrogen bonds** are weaker than **covalent bonds**. A hydrogen bond is an attractive force between a hydrogen atom covalently bonded to a more electronegative atom (e.g., oxygen, nitrogen) and another electronegative atom.

Step 2: Covalent Bonding in CH_4.
- **CH_4** (methane) has covalent bonds between carbon and hydrogen atoms.

Step 3: Conductivity of Covalent Compounds.
- **Covalent compounds** generally do not conduct electricity unless they are in molten form or dissolved in water. However, **diamond** is an exception because it is a covalent network solid that does not conduct electricity.

Step 4: Graphite Properties.
- **Graphite** is a soft solid and a good conductor of electricity due to the mobility of electrons between layers.

Step 5: Conclusion.
Thus, the correct statements are:
- **Hydrogen bond is weaker than covalent bond.**
- **CH_4 has covalent bonds.**
- **Graphite is a soft solid and a good conductor of electricity.**

Final Answer:

$$\boxed{\text{(A), (B) and (D) only}}$$

Quick Tip

Hydrogen bonds are weaker than covalent bonds. Graphite is soft and conductive, while covalent compounds generally do not conduct electricity.

---

63. Which option is true for Fischer projection formulas?

(A) They must be kept in the plane of paper.
(B) They are not allowed to flip them over.
(C) They must be rotated in the plane of paper by 90°.
(D) They must be rotated in the plane of paper by 180°.

Choose the correct answer from the options given below:

(1) (A), (B) and (D) only.
(2) (A), (B) and (C) only.
(3) (A), (B), (C) and (D).
(4) (B) and (D) only.

Correct Answer: (2) (A), (B) and (C) only.
Solution: Step 1: Fischer projection formula rules.
- Fischer projections represent molecules in a 2D plane with vertical and horizontal bonds to show the configuration of stereoisomers.
- **(A)**: Fischer projections must be in the plane of the paper to represent the correct 3D configuration.
- **(B)**: The molecule can be flipped over in the Fischer projection, but it would reverse the configuration of the chiral centers, which is not allowed in certain cases.
- **(C)**: Fischer projections can be rotated by 90° in the plane, and the configuration remains the same for simple molecules.
- **(D)**: A 180° rotation of a Fischer projection would change the configuration, so it is not allowed.

Step 2: Conclusion. Thus, the correct option is:

(A), (B), and (C)

Final Answer:

$$\boxed{\text{(A), (B) and (C) only}}$$

Quick Tip

In Fischer projections, you can rotate by 90° but not 180°, and the structure must remain in the plane of the paper.

---

64. Which of the following halides will undergo S_2 reaction?

(A) Chlorobenzene
(B) Benzyl chloride
(C) Tertiary-butyl chloride
(D) n-butyl chloride

Choose the correct answer from the options given below:
(1) (B) and (D) only.
(2) (B), (C) and (D) only.
(3) (A), (B) and (D) only.
(4) (A), (C) and (D) only.

Correct Answer: (1) (B) and (D) only.
Solution: Step 1: Mechanism of S_2 reaction.
The S_2 reaction (bimolecular nucleophilic substitution) requires a backside attack on the elec-

trophilic carbon. It typically occurs with primary or secondary alkyl halides, as well as with benzyl and allyl halides.

Step 2: Analyze each halide.
- **Chlorobenzene (A)**: The carbon attached to the halogen is sp^2 hybridized, making it very resistant to nucleophilic attack. It does not undergo an S_2 reaction.
- **Benzyl chloride (B)**: The benzyl group stabilizes the transition state, making this halide very reactive in an S_2 reaction.
- **Tertiary-butyl chloride (C)**: Due to the steric hindrance around the tertiary carbon, this halide does not undergo S_2 reactions but follows an S_N1 mechanism.
- **n-butyl chloride (D)**: This is a primary halide and undergoes S_2 reactions very efficiently.

Step 3: Conclusion.
Thus, the halides that undergo S_2 reactions are **Benzyl chloride (B)** and **n-butyl chloride (D)**.

Final Answer:

$$\boxed{\text{(B) and (D) only}}$$

Quick Tip

S_2 reactions are favored by primary halides, benzyl halides, and allyl halides due to less steric hindrance.

---

65. The third law of thermodynamics relates to

1. The entropy of a perfect crystal at absolute zero temperature.
2. The relation between work and heat.
3. Evolution of entropy of a system with time.
4. Conservation of mass.

Choose the correct answer from the options given below:
(1) (A) only.
(2) (B) only.
(3) (C) only.
(4) (D) only.

Correct Answer: (1) The entropy of a perfect crystal at absolute zero temperature.
Solution:
Step 1: Understand the third law of thermodynamics. The third law of thermodynamics states that the entropy of a perfect crystal at absolute zero temperature (0 K) is exactly zero. This is because, at 0 K, the system is in its ground state, and no randomness or disorder exists.

Step 2: Explanation of other options.
- **(B)**: This refers to the first and second laws of thermodynamics.

- **(C)**: Entropy evolution with time is a broader concept covered by the second law of thermodynamics.
- **(D)**: Conservation of mass is described by the law of conservation of mass, not the third law of thermodynamics.

Step 3: Conclusion.
Thus, the third law of thermodynamics specifically deals with the entropy of a perfect crystal at absolute zero.

Final Answer:

$$\boxed{\text{(A) only}}$$

Quick Tip

The third law of thermodynamics states that at absolute zero, the entropy of a perfect crystal is zero.

---

66. Match List-I with List-II

List-I	List-II
(A) Snell's Law	(I) Perfect Dimagnetism
(B) Meissner Effect	(II) Refractive Index
(C) Brewster's Law	(III) Polarized Light
(D) Photoelectric Effect	(IV) Quantum theory of light

Choose the correct answer from the options given below:
(1) (A) (II), (B) (1), (C) (III), (D) (IV)
(2) (A) (II), (B) (III), (C) (I), (D) (IV)
(3) (A) (I), (B) (II), (C) (IV), (D) (III)
(4) (A) (III), (B) (IV), (C) (I), (D) (II)

Correct Answer: (2) (A) (II), (B) (III), (C) (I), (D) (IV)
Solution: Step 1: Understand each law/phenomenon.
- **Snell's Law (A)** relates to the refractive index of materials when light passes from one medium to another, so it matches with **(II) Refractive Index**.
- **Meissner Effect (B)** refers to perfect diamagnetism, where a superconductor expels all magnetic fields. Thus, it matches with **(I) Perfect Dimagnetism**.
- **Brewster's Law (C)** describes the angle at which light with a particular polarization is perfectly reflected, hence it matches with **(III) Polarized Light**.
- **Photoelectric Effect (D)** relates to the emission of electrons from a material when exposed to light, and it is explained by quantum theory, matching with **(IV) Quantum theory of light**.

Step 2: Conclusion. Thus, the correct matching is:

(A) (II), (B) (I), (C) (III), (D) (IV)

Final Answer:

$$\boxed{\text{(A) (II), (B) (III), (C) (I), (D) (IV)}}$$

Quick Tip

Snell's Law = Refractive Index; Meissner Effect = Perfect Dimagnetism; Brewster's Law = Polarized Light; Photoelectric Effect = Quantum theory.

---

67. Match List-I with List-II

List-I	List-II
Atom	Electronegativity value (on Pauling Scale)
(A) Li	(1) 1.0
(B) Na	(II) 0.7
(C) K	(III) 0.9
(D) Cs	(IV) 0.8

Choose the correct answer from the options given below:
(1) (A) (I), (B) (III), (C) (IV), (D) (II)
(2) (A) (I), (B) (III), (C) (II), (D) (IV)
(3) (A) (I), (B) (II), (C) (IV), (D) (III)
(4) (A) (III), (B) (IV), (C) (I), (D) (II)

Correct Answer: (3) (A) (I), (B) (II), (C) (IV), (D) (III)
Solution:
- **Li (A)** has the highest electronegativity in the alkali metals, approximately **1.0**.
- **Na (B)** has an electronegativity of **0.9**.
- **K (C)** has an electronegativity of **0.8**.
- **Cs (D)** has the lowest electronegativity of these elements, **0.7**.

Conclusion:
Thus, the correct answer is:

(A) (I), (B) (II), (C) (IV), (D) (III)

Final Answer:

$$\boxed{\text{(A) (I), (B) (II), (C) (IV), (D) (III)}}$$

Quick Tip

Electronegativity decreases as you move down the alkali metals group.

68. Match List-I with List-II

List-I	List-II
Name of the Carbon compound	Oxidation state of the Carbon
(A) Methanol	(I) -2
(B) Formaldehyde	(II) 0
(C) Formic Acid	(III) +2

Choose the correct answer from the options given below:
(1) (A) (I), (B) (II), (C) (III)
(2) (A) (I), (B) (III), (C) (II)
(3) (A) (II), (B) (III), (C) (I)
(4) (A) (III), (B) (II), (C) (I)

Correct Answer: (1) (A) (I), (B) (II), (C) (III)
Solution:
- **Methanol (A)** has a carbon in the -2 oxidation state (since the hydroxyl group makes the carbon more reduced).
- **Formaldehyde (B)** has a carbon in the **0** oxidation state.
- **Formic acid (C)** has a carbon in the **+2** oxidation state, as it is bonded to both an oxygen (via a double bond) and a hydroxyl group.

Conclusion:
Thus, the correct answer is:

(A) (I), (B) (II), (C) (III)

Final Answer:

$$\boxed{\text{(A) (I), (B) (II), (C) (III)}}$$

Quick Tip

The oxidation state of carbon in formaldehyde is 0, in methanol is -2, and in formic acid is +2.

69. Match List-I with List-II

List-I	List-II
Molecules	Most Reactive towards
(A) Ethyl bromide	(I) S_N1
(B) Tertiary butyl bromide	(II) S_N2
(C) Acetone	(III) Electrophilic substitution
(D) Benzene	(IV) Nucleophilic addition

Choose the correct answer from the options given below:
(1) (A) (II), (B) (I), (C) (IV), (D) (III)
(2) (A) (I), (B) (III), (C) (II), (D) (IV)
(3) (A) (I), (B) (II), (C) (IV), (D) (III)
(4) (A) (III), (B) (IV), (C) (I), (D) (II)

Correct Answer: (3) (A) (I), (B) (II), (C) (IV), (D) (III)
Solution:
- **Ethyl bromide (A)** undergoes **S_N2** reaction (bimolecular nucleophilic substitution) because it is a primary alkyl halide.
- **Tertiary butyl bromide (B)** undergoes **S_N1** reaction (unimolecular nucleophilic substitution) due to the stable carbocation formed.
- **Acetone (C)** reacts with nucleophiles via **nucleophilic addition** due to the presence of a carbonyl group.
- **Benzene (D)** is reactive towards **electrophilic substitution** because of its aromatic nature.

Step 2: Conclusion.
Thus, the correct matching is:

(A) (I), (B) (II), (C) (IV), (D) (III)

Final Answer:

$$\boxed{\text{(A) (I), (B) (II), (C) (IV), (D) (III)}}$$

Quick Tip

Ethyl bromide undergoes S_N2, tertiary-butyl bromide undergoes S_N1, acetone reacts via nucleophilic addition, and benzene undergoes electrophilic substitution.

---

70. Match List-I with List-II

List-I	List-II
Number of carbon atoms	Number of structural isomers
(A) C4H10	(1) 2
(B) C5H12	(II) 3
(C) C6H14	(III) 5
(D) C7H16	(IV) 9

Choose the correct answer from the options given below:
(1) (A) (1), (B) (III), (C) (IV), (D) (II)
(2) (A) (1), (B) (III), (C) (II), (D) (IV)
(3) (A) (1), (B) (II), (C) (IV), (D) (III)

(4) (A) (1), (B) (II), (C) (III), (D) (IV)

Correct Answer: (4) (A) (1), (B) (II), (C) (III), (D) (IV)
Solution: Step 1: Analyze number of structural isomers.
- **C4H10 (A)**: There are **2** structural isomers for butane.
- **C5H12 (B)**: There are **3** structural isomers for pentane.
- **C6H14 (C)**: There are **5** structural isomers for hexane.
- **C7H16 (D)**: There are **9** structural isomers for heptane.

Step 2: Conclusion.
Thus, the correct matching is:

(A) (1), (B) (II), (C) (III), (D) (IV)

Final Answer:

$$\boxed{\text{(A) (1), (B) (II), (C) (III), (D) (IV)}}$$

Quick Tip

The number of structural isomers increases with the number of carbon atoms and branching possibilities.

---

71. Match List-I with List-II

List-I	List-II
Name of the process	Equipment used
(A) Biolistics	(I) Gene pulser
(B) Agrobacterium	(II) PDS 1000/He
(C) Electroporation	(III) Micromanipulator
(D) Microinjection	(IV) Vir C1

Choose the correct answer from the options given below:
(1) (A) (I), (B) (II), (C) (III), (D) (IV)
(2) (A) (II), (B) (IV), (C) (I), (D) (III)
(3) (A) (I), (B) (II), (C) (IV), (D) (III)
(4) (A) (III), (B) (IV), (C) (I), (D) (II)

Correct Answer: (2) (A) (II), (B) (IV), (C) (I), (D) (III)
Solution:
- **Biolistics (A)**: This method uses the **PDS 1000/He** for particle bombardment to deliver genetic material into cells.
- **Agrobacterium (B)**: This method uses the **Vir C1** system to transfer genes into plants.
- **Electroporation (C)**: The **Gene pulser** is used to apply an electric field to introduce DNA into cells.

- **Microinjection (D)**: The **Micromanipulator** is used to inject genetic material into cells manually.

Step 2: Conclusion.
Thus, the correct matching is:

(A) (II), (B) (IV), (C) (I), (D) (III)

Final Answer:

(A) (II), (B) (IV), (C) (I), (D) (III)

Quick Tip

Biolistics uses particle bombardment, while Agrobacterium, electroporation, and microinjection involve gene transfer via different tools.

---

72. Match List-I with List-II

List-I	List-II
Name of the process	Reaction/Conversion
(A) Ammonification	(I) Conversion of atmospheric nitrogen into ammonia
(B) Denitrification	(II) Conversion of organic nitrogen into ammonium
(C) Nitrification	(III) Conversion of nitrite or nitrate into atmospheric nitrogen
(D) Nitrogen fixation	(IV) Conversion of ammonia into nitrate and nitrite

Choose the correct answer from the options given below:
(1) (A) (I), (B) (II), (C) (III), (D) (IV)
(2) (A) (II), (B) (III), (C) (IV), (D) (I)
(3) (A) (I), (B) (II), (C) (IV), (D) (III)
(4) (A) (III), (B) (IV), (C) (I), (D) (II)

Correct Answer: (2) (A) (II), (B) (III), (C) (IV), (D) (I)
Solution:
- **Ammonification (A)**: The conversion of organic nitrogen (from dead organisms) into ammonium (NH_4^+) is called ammonification.
- **Denitrification (B)**: The process where **nitrate (NO_3^-)** is reduced to nitrogen gas (N_2), releasing it into the atmosphere.
- **Nitrification (C)**: The conversion of **ammonia** (NH_3) into **nitrate and nitrite** by nitrifying bacteria.
- **Nitrogen fixation (D)**: The process of converting **atmospheric nitrogen (N_2)** into **ammonia (NH_3)** by nitrogen-fixing bacteria.

Step 2: Conclusion.
Thus, the correct matching is:

(A) (II), (B) (III), (C) (IV), (D) (I)

Final Answer:

$$\boxed{\text{(A) (II), (B) (III), (C) (IV), (D) (I)}}$$

Quick Tip

Ammonification = organic nitrogen to ammonium, Denitrification = nitrate to nitrogen, Nitrification = ammonia to nitrate, Nitrogen fixation = atmospheric nitrogen to ammonia.

---

73. Match List-I with List-II

List-I	List-II
(A) DNA footprinting	(I) Protein-Protein interaction
(B) Yeast two hybrid system	(II) VNTR
(C) DNA Fingerprinting	(III) DNA binding proteins
(D) SAGE	(IV) Transcriptome analysis

Choose the correct answer from the options given below:
(1) (A) (I), (B) (II), (C) (III), (D) (IV)
(2) (A) (I), (B) (III), (C) (II), (D) (IV)
(3) (A) (III), (B) (I), (C) (II), (D) (IV)
(4) (A) (III), (B) (IV), (C) (I), (D) (II)

Correct Answer: (3) (A) (III), (B) (I), (C) (II), (D) (IV)
Solution:
- **DNA footprinting (A)**: This method identifies DNA binding sites of proteins, so it matches with **(III) DNA binding proteins**.
- **Yeast two hybrid system (B)**: This system detects **protein-protein interactions**, hence it matches with **(I) Protein-Protein interaction**.
- **DNA Fingerprinting (C)**: This technique uses **VNTR (Variable Number Tandem Repeats)** to identify individuals, so it matches with **(II) VNTR**.
- **SAGE (D)**: SAGE is used for **transcriptome analysis**, so it matches with **(IV) Transcriptome analysis**.

Step 2: Conclusion.
Thus, the correct matching is:

$$\text{(A) (III), (B) (I), (C) (II), (D) (IV)}$$

Final Answer:

$$\boxed{\text{(A) (III), (B) (I), (C) (II), (D) (IV)}}$$

Quick Tip

DNA footprinting identifies DNA-protein interactions, Yeast two hybrid detects protein interactions, SAGE analyzes transcriptomes, and DNA fingerprinting uses VNTR.

---

74. Match List-I with List-II

List-I	**List-II**
Coordination compound	Crystal Field stabilization energy (ignore pairing energy)
(A) [Fe(CN)]	(I) 0Dq
(B) [Cu(CN)]	(II) -24Dq
(C) [Ni(Cl)]	(III) -6Dq
(D) [Zn(CN)]	(IV) -12Dq

Choose the correct answer from the options given below:
(1) (A) (I), (B) (II), (C) (II), (D) (IV)
(2) (A) (II), (B) (II), (C) (I), (D) (III)
(3) (A) (I), (B) (II), (C) (III), (D) (IV)
(4) (A) (III), (B) (IV), (C) (I), (D) (II)

Correct Answer: (3) (A) (I), (B) (II), (C) (III), (D) (IV)
Solution:
- **[Fe(CN)] (A)**: Iron in this complex is low-spin, leading to a **0Dq** crystal field splitting energy.
- **[Cu(CN)] (B)**: Copper in this complex leads to a larger crystal field splitting energy of **-24Dq**.
- **[Ni(Cl)] (C)**: Nickel in this complex gives a crystal field splitting of **-6Dq**.
- **[Zn(CN)] (D)**: Zinc in this complex exhibits a moderate crystal field splitting energy of **-12Dq**.

Step 2: Conclusion.
Thus, the correct matching is:

$$\text{(A) (I), (B) (II), (C) (III), (D) (IV)}$$

Final Answer:

$$\boxed{\text{(A) (I), (B) (II), (C) (III), (D) (IV)}}$$

Quick Tip

The crystal field splitting energy depends on the metal ion, ligand field, and whether the complex is high-spin or low-spin.

---

75. Match List-I with List-II

List-I	List-II
Compounds	Related properties
(A) Aniline	(I) meta director and deactivator
(B) Nitrobenzene	(II) o
p director and deactivator	
(C) Chlorobenzene	(III) o
p director and activator	
(D) Allene	(IV) Central atom sp hybridized

Choose the correct answer from the options given below:
(1) (A) (III), (B) (I), (C) (II), (D) (IV)
(2) (A) (I), (B) (III), (C) (II), (D) (IV)
(3) (A) (I), (B) (II), (C) (IV), (D) (III)
(4) (A) (IV), (B) (III), (C) (II), (D) (I)

Correct Answer: (2) (A) (I), (B) (III), (C) (II), (D) (IV)
Solution:
- **Aniline (A)**: Aniline is an **activating group** and **ortho/para-directing** because the amino group donates electron density to the ring.
- **Nitrobenzene (B)**: The nitro group is a **deactivating group** and **meta-directing** due to its electron-withdrawing nature.
- **Chlorobenzene (C)**: The chlorine group is a **mild activating group** and **ortho/para-directing** due to its lone pairs, but it also withdraws electron density via induction.
- **Allene (D)**: Allene has a **central sp-hybridized atom**, making it linear.

Step 2: Conclusion.
Thus, the correct matching is:

(A) (I), (B) (III), (C) (II), (D) (IV)

Final Answer:

$$\boxed{\text{(A) (I), (B) (III), (C) (II), (D) (IV)}}$$

Quick Tip

Aniline is an activator and ortho/para-directing, nitrobenzene is deactivating and meta-directing, chlorobenzene is mildly activating and ortho/para-directing, and allenes have central sp hybridization.