GPAT 2024 Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :500	Total Questions :125

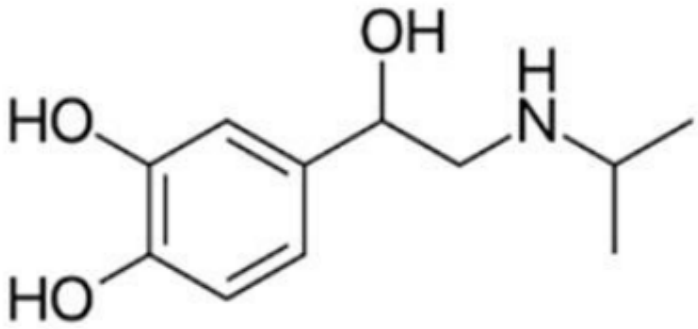
General Instructions

Read the following instructions very carefully and strictly follow them:

1. All questions are compulsory.
2. For every correct answer, 4 marks are awarded.
3. For every incorrect answer, 1 mark is deducted.
4. No marks will be deducted for unattempted questions.

Section A

1. The below structure represents the drug:



(A) Isoprenaline

(B) Amphetamine

(C) Norepinephrine

(D) Salbutamol

Correct Answer: (A) Isoprenaline

Solution:

Step 1: Identifying the Structural Features

The given structure corresponds to Isoprenaline, also known as Isoproterenol. The key identifying features include:

- A benzene ring with two hydroxyl groups (-OH) attached at positions 1 and 2, forming a catechol structure.
- A side chain containing a primary amine (-NH group), a characteristic feature of sympathomimetic drugs.

Step 2: Differentiating from Similar Compounds

- Isoprenaline vs. Norepinephrine: - Norepinephrine has a hydroxy (-OH) group on the side chain, whereas Isoprenaline does not. - Isoprenaline contains an additional methyl (CH_3) group attached to the amine, which distinguishes it from norepinephrine.
- Isoprenaline vs. Amphetamine: - Amphetamine lacks the catechol hydroxyl groups and instead has a simple benzene ring with an amine group.
- Isoprenaline vs. Salbutamol: - Salbutamol has a tert-butyl group on the amine instead of a methyl group and is primarily used for asthma treatment.

Step 3: Confirming the Identity

The presence of the catechol hydroxyl groups and the methyl-substituted amine confirms that the given structure is Isoprenaline.

Quick Tip

- Catecholamines like Isoprenaline, Norepinephrine, and Dopamine have hydroxyl (-OH) groups on a benzene ring. - Isoprenaline is unique because it contains a methyl ($-CH_3$) substitution on the amine group, differentiating it from Norepinephrine.

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2. Chikusetsu saponin is present in:

(A) Senega

(B) Quillia

(C) Ginseng

(D) Liquorice

Correct Answer: (C) Ginseng

Solution: Chikusetsu saponin is a compound found primarily in Ginseng. It is one of the active components responsible for the medicinal effects of Ginseng, such as its adaptogenic and anti-fatigue properties.

Chikusetsu saponin is a bioactive compound found in ginseng. While senega contains senegasaponins, quillia contains quillaic acid saponins, and liquorice contains glycyrrhizin, none of these specifically contain chikusetsu saponin. Thus, the correct answer is **(C)** Ginseng.

Quick Tip

In plant-based pharmacology, saponins like Chikusetsu are often found in roots like those of Ginseng, and they contribute to the plant's therapeutic effects.

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3. What is the best time to collect the medicinal bark material?

(A) Post flowering

(B) Before the leaf falls

(C) Pre flowering

(D) After the leaf falls

Correct Answer: (D) After the leaf falls

Solution:

The best time to collect medicinal bark is after the leaf falls, as this ensures that the plant is in its dormant phase, reducing stress and damage. During this period, the active phytochemical compounds are at their highest concentration, and there is minimal sap flow, making the bark easier to peel and store.

Collecting the bark at other stages is less effective. Post-flowering (A) is a phase where the plant directs its resources to seed production, resulting in lower medicinal compound concentration. Before the leaf falls (B), the tree is actively transporting nutrients, leading to a higher moisture content in the bark. Pre-flowering (C) is another phase where the plant is focusing on bud and flower formation rather than storing medicinal compounds in the bark. Thus, harvesting bark after the leaves have fallen ensures maximum potency and better preservation of medicinal properties.

Quick Tip

- Medicinal bark should be harvested after leaf fall to maximize phytochemical concentration. - Avoid collection during active growth phases (flowering, pre-flowering) when nutrient transport is high. - Low sap flow during dormancy makes drying and preservation easier.

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4. Which of the following steps are not involved in gravimetric analysis:

(A) Precipitation

(B) Indicator

(C) Digestion

(D) Filtration

Correct Answer: (B) Indicator

Solution: Gravimetric analysis involves precipitation, digestion, and filtration as key steps. The process does not require the use of an indicator, as it relies on the mass of the precipitate for analysis rather than any visual change that would require an indicator.

Quick Tip

In gravimetric analysis, focus on the techniques that involve separating and weighing the precipitate, such as precipitation, digestion, and filtration.

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5. Which of the following is a meta directing group?

(A) F

(B) $NHCH_3$

(C) NH_2

(D) CF_3

Correct Answer: (D) CF_3

Solution:

A meta-directing group is an electron-withdrawing group that decreases electron density at the ortho and para positions of a benzene ring, making electrophilic substitution more likely at the meta position.

Among the given options, CF_3 is a strong electron-withdrawing group due to the high electronegativity of fluorine atoms. It exerts a -I (inductive withdrawing) effect, pulling electron density away from the benzene ring and making the ortho and para positions less reactive to electrophiles. As a result, substitution occurs at the meta position.

On the other hand: - Fluorine (F) is an electron-withdrawing group by inductive effect (-I) but has a +M (mesomeric donating) effect, making it an ortho/para director. - Amines (NH_2, $NHCH_3$) are strong electron-donating groups due to their +M effect (resonance donation), which increases electron density at the ortho and para positions, making them ortho/para directors.

Since CF_3 is the only strong electron-withdrawing group without a significant resonance donating effect, it is the correct meta-directing group.

Quick Tip

- Electron-withdrawing groups (e.g., NO_2, CF_3, COOH) are meta-directors because they reduce electron density at ortho/para positions. - Electron-donating groups (e.g., NH_2, OH, OCH_3) are ortho/para directors due to their resonance donating effect. - Fluorine and other halogens are exceptions: they withdraw inductively (-I) but donate mesomerically (+M), making them ortho/para directors.

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6. The Wilson's disease is a rare inherited disorder due to accumulation in brain, liver, and other vital organs of:

(A) Iodine

(B) Copper

(C) Iron

(D) Calcium

Correct Answer: (B) Copper

Solution: Wilson's disease is a rare inherited disorder characterized by the accumulation of copper in vital organs such as the brain, liver, and kidneys. This accumulation leads to various neurological and hepatic symptoms.

Quick Tip

Wilson's disease involves copper buildup due to a defect in copper transport. Early diagnosis and treatment can prevent serious organ damage.

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7. The starting raw material for synthesis of lignocaine is:

(A) 2,6-Xylidine

(B) p-Nitroacetophenone

(C) 4-Amino-3-Nitroanisole

(D) 4-Chlorobenzyl cyanide

Correct Answer: (A) 2,6-Xylidine

Solution: The starting raw material for the synthesis of lignocaine (also known as lidocaine) is 2,6-Xylidine. This compound undergoes a series of reactions to form the final anesthetic compound.

Quick Tip

Lignocaine synthesis begins with aromatic amines like 2,6-Xylidine that are modified through various chemical processes to form the anesthetic agent.

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8. Coating of Eudragit NE40D on tablets is done to prepare:

(A) Sublingual tablets

(B) IR tablets

(C) CR tablets

(D) Buccal tablets

Correct Answer: (C) CR tablets

Solution: Eudragit NE40D is a polymer used in the preparation of controlled-release (CR) tablets. It provides a controlled release of the active pharmaceutical ingredient, ensuring sustained drug delivery over a longer period.

Quick Tip

For sustained or controlled release formulations, polymers like Eudragit are used to modify the release rate of the drug from the tablet.

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9. During compression of tablets, dwell time is:

(A) Time it takes for the punches to punch tablet

(B) Time it takes for the punches to stop moving vertically and to achieve maximum penetration in the die under the primary compression rollers

(C) Time it takes for the punches to eject the tablets

(D) Time it takes for the punches to eject tablet under the primary compression rollers

Correct Answer: (B) Time it takes for the punches to stop moving vertically and to achieve maximum penetration in the die under the primary compression rollers

Solution: Dwell time in tablet compression refers to the period when the punches stop moving vertically to allow for maximum penetration of the powder in the die under the primary compression rollers. This time is crucial for proper tablet formation and compaction.

Quick Tip

Dwell time is important for ensuring proper tablet hardness and uniformity. It allows the material to compress fully and reach the desired tablet quality.

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10. According to the SAR of Chloroquine, electron:

(A) Withdrawing group at 6th position of the quinoline ring is important for the inhibition of hemozoin formation

(B) Donating group at 7th position of the quinoline ring is important for the inhibition of hemozoin formation

(C) Donating group at 6th position of the quinoline ring is important for the inhibition of hemozoin formation

(D) Withdrawing group at 7th position of the quinoline ring is important for the inhibition of hemozoin formation

Correct Answer: (D) Withdrawing group at 7th position of the quinoline ring is important for the inhibition of hemozoin formation

Solution:

The Structure-Activity Relationship (SAR) of Chloroquine indicates that the quinoline ring plays a crucial role in the drug's ability to inhibit hemozoin formation, which is essential for its antimalarial activity. The presence of an electron-withdrawing group at the 7th position of the quinoline ring enhances the drug's potency by stabilizing interactions with the target site and inhibiting the polymerization of heme into hemozoin.

Quick Tip

- Chloroquine's antimalarial activity depends on its ability to inhibit hemozoin formation. - Electron-withdrawing groups at the 7th position enhance this inhibition. - Electron-donating groups decrease efficacy by altering drug-target interactions.

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11. Size of a pilot plant batch is:

(A) $\frac{1}{10}$th of marketing batch

(B) $\frac{1}{5}$th of production batch

(C) $\frac{1}{5}$th of marketing batch

(D) $\frac{1}{10}$th of production batch

Correct Answer: (D) $\frac{1}{10}$th of production batch

Solution:

A pilot plant batch is a small-scale version of a full-scale production batch and is used to optimize manufacturing parameters before large-scale production. The typical size of a pilot batch is approximately 1/10th of the production batch size, allowing for process validation and testing before large-scale commercialization.

Why Other Options Are Incorrect: - (A) $\frac{1}{10}$th of marketing batch: Marketing batches refer to those distributed in the market, which may not directly correlate with production scaling. - (B) $\frac{1}{5}$th of production batch: Pilot batches are typically smaller, around 1/10th of the production scale. - (C) $\frac{1}{5}$th of marketing batch: Marketing batches are usually determined based on regulatory approvals and distribution plans, not production scaling.

Thus, the correct answer is that a pilot plant batch is typically 1/10th of the production batch, ensuring cost-effective testing and optimization before full-scale manufacturing.

Quick Tip

- Pilot plant batch is typically 1/10th of the production batch for scale-up and validation. - It helps optimize manufacturing parameters before large-scale production. - Marketing batches refer to batches intended for commercial distribution and do not determine pilot batch size.

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12. Nitrostat® is an example of:

(A) CR tablet

(B) Bolus tablet

(C) Sublingual tablet

(D) Effervescent tablet

Correct Answer: (C) Sublingual tablet

Solution: Nitrostat® is an example of a sublingual tablet. These tablets are designed to be placed under the tongue for rapid absorption, especially for drugs like nitroglycerin, which are used to treat chest pain (angina).

Quick Tip

Sublingual tablets are used for quick drug absorption through the mucous membranes under the tongue, bypassing the digestive system for faster effects.

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13. The dried juice of Pterocarpus marsupium belongs to the family:

(A) Leguminosae

(B) Asteraceae

(C) Rosaceae

(D) Liliaceae

Correct Answer: (A) Leguminosae

Solution: The dried juice of Pterocarpus marsupium belongs to the Leguminosae family,

which is also known as the pea or legume family. This plant is known for its medicinal properties and is commonly used in traditional medicine.

Quick Tip

When identifying plant families, recognize that Leguminosae (or Fabaceae) includes many plants known for their nitrogen-fixing ability and medicinal properties, such as Pterocarpus marsupium.

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14. Spin Quantum number of ^{13}C NMR is:

(A) $\frac{1}{4}$

(B) $\frac{1}{2}$

(C) $\frac{3}{2}$

(D) $\frac{1}{3}$

Correct Answer: (B) $\frac{1}{2}$

Solution:

The spin quantum number (I) of a nucleus determines whether it is NMR active and affects its behavior in a magnetic field. The nucleus of Carbon-13 (^{13}C) has a spin quantum number of $\frac{1}{2}$.

- Carbon-12 (^{12}C) has a spin quantum number of 0 and is NMR inactive. - Carbon-13 (^{13}C) is NMR active because it has an odd number of neutrons, resulting in a nonzero spin quantum number $I = \frac{1}{2}$. - Nuclei with $I = \frac{1}{2}$ (such as ^{1}H and ^{13}C) are the most commonly studied in NMR spectroscopy because they exhibit simple splitting patterns and good sensitivity.

Why Other Options Are Incorrect: - (A) $\frac{1}{4}$, (C) $\frac{3}{2}$, (D) $\frac{1}{3}$: These values do not correspond to the spin quantum number of ^{13}C. Most nuclei with nonzero spin have values of $I = \frac{1}{2}, 1, \frac{3}{2}, 2$, etc., but ^{13}C specifically has $I = \frac{1}{2}$.

Thus, the correct answer is $\frac{1}{2}$, confirming that ^{13}C is NMR active and useful in structural determination using ^{13}C NMR spectroscopy.

Quick Tip

- NMR-active nuclei have a nonzero spin quantum number ($I \neq 0$). - ^{13}C has $I = \frac{1}{2}$, making it ideal for NMR spectroscopy. - ^{12}C is NMR inactive because it has $I = 0$.

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15. The rate limiting step for the absorption of controlled release tablet is the:

(A) Metabolism of the drug

(B) Excretion of the drug

(C) Dissolution of the drug

(D) Distribution of the drug

Correct Answer: (C) Dissolution of the drug

Solution: For controlled release tablets, the rate limiting step for absorption is typically the dissolution of the drug. This is because the drug needs to dissolve in the gastrointestinal tract before it can be absorbed into the bloodstream. The controlled release mechanism is designed to slow down the dissolution rate for prolonged therapeutic effect.

Quick Tip

In controlled release formulations, the dissolution of the drug is often the slowest step, determining the overall release and absorption rate.

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16. Which antibiotic undergoes light catalysed autoxidation:

(A) Polyene antibiotics

(B) Beta lactum antibiotics

(C) Sugar derived antibiotics

(D) Macrolide antibiotics

Correct Answer: (A) Polyene antibiotics

Solution: Polyene antibiotics undergo light-catalysed autoxidation, a process where exposure to light accelerates the oxidation of the antibiotic. This leads to the breakdown of the polyene structure, rendering the antibiotic less effective. This is a significant consideration in the storage and handling of such antibiotics.

Quick Tip

Polyene antibiotics, like amphotericin B, are sensitive to light and oxygen, which can cause autoxidation. Always store them in dark conditions to preserve their efficacy.

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17. Which of the following is not a method for solubility enhancement:

(A) Crystallization

(B) Co-solvency

(C) Salt formation

(D) Hydrotropy

Correct Answer: (A) Crystallization

Solution: Crystallization is not a method for solubility enhancement. In fact, crystallization is typically used to purify compounds and reduce solubility in a solvent. In contrast, co-solvency, salt formation, and hydrotropy are methods used to improve the solubility of poorly soluble drugs.

Quick Tip

When enhancing solubility, consider using co-solvency (using multiple solvents), salt formation (converting the drug into a more soluble salt), or hydrotropy (using a solubilizing agent) rather than crystallization.

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18. Schedule T of Drugs and Cosmetics Rules, 1945 deals with:

(A) GMP for ASU drugs

(B) GLP and requirement of premises and equipments

(C) GMP for Homeopathy medicine

(D) GMP for Pharmaceutical product

Correct Answer: (A) GMP for ASU drugs

Solution: Schedule T of the Drugs and Cosmetics Rules, 1945 deals with the Good Manufacturing Practices (GMP) for Ayurvedic, Siddha, and Unani (ASU) drugs. It sets out the requirements for the manufacturing, storage, and distribution of these traditional

medicines to ensure their quality and safety.

Quick Tip

Schedule T is specific to ASU drugs and outlines GMP standards to ensure that these traditional medicines are manufactured in a safe and effective manner.

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19. The key intermediate for the biosynthesis of C6-C3 units is:

(A) Pyruvic acid

(B) Shikimic acid

(C) Dehydroquinic acid

(D) Mevalonic acid

Correct Answer: (B) Shikimic acid

Solution: Shikimic acid is the key intermediate for the biosynthesis of C6-C3 units in the pathway that leads to the synthesis of aromatic compounds in plants and microorganisms. This acid plays a crucial role in the shikimate pathway, which is responsible for the production of many essential metabolites, including aromatic amino acids.

Quick Tip

Shikimic acid is central to the biosynthesis of aromatic compounds, including the C6-C3 units, which are essential for the production of several biologically active molecules.

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20. Rancidity of oil is detected by:

(A) Saponification value

(B) Iodine value

(C) Peroxide value

(D) Acid value

Correct Answer: (C) Peroxide value

Solution: Peroxide value is used to detect rancidity in oils. It measures the amount of peroxides (primary oxidation products) present in the oil, which are formed during the oxidation process. The higher the peroxide value, the greater the extent of rancidity in the oil.

Quick Tip

Peroxide value is an indicator of the early stages of oxidation in oils. A higher peroxide value signifies that the oil is more likely to be rancid.

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21. Which one of the following enzymes comprises a major part of enzyme-linked receptors:

(A) Receptor Histidine Kinase

(B) Receptor Threonine Phosphatase

(C) Receptor Serine Phosphatase

(D) Receptor Tyrosine Kinase

Correct Answer: (D) Receptor Tyrosine Kinase

Solution: Receptor Tyrosine Kinase is a major component of enzyme-linked receptors. These receptors are involved in the activation of signaling pathways through the phosphorylation of tyrosine residues on specific proteins, leading to cellular responses like growth and differentiation.

Quick Tip

Receptor Tyrosine Kinases (RTKs) play a key role in cellular communication and are essential for many important signaling pathways, particularly in regulating cell growth and metabolism.

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22. Core tablet coated with cellulose acetate phthalate has been administered to a patient. Where do you expect the drug to be released:

(A) Liver

(B) Intestine

(C) Oral cavity

(D) Stomach

Correct Answer: (B) Intestine

Solution: Cellulose acetate phthalate (CAP) is a pH-sensitive coating that is designed to dissolve in the intestine, which has a higher pH compared to the stomach. This allows the

drug to be released in the intestine, avoiding degradation in the acidic environment of the stomach.

Quick Tip

Cellulose acetate phthalate (CAP) coatings are commonly used for enteric coatings, ensuring drug release in the intestine where the pH is more favorable for the dissolution of the coating.

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23. Examples of BCS class III drugs are:

(A) Acyclovir, Atenolol, Captopril

(B) Taxol, Ellagic acid, Aspirin

(C) Aspirin, Paracetamol, Amoxycillin

(D) Chloroquine, Diltiazem, Metoprolol

Correct Answer: (A) Acyclovir, Atenolol, Captopril

Solution: BCS Class III drugs are characterized by high solubility and low permeability. Drugs like Acyclovir, Atenolol, and Captopril fall under this class due to their high solubility but relatively low permeability across the gastrointestinal tract. These drugs often benefit from formulations that enhance their absorption.

Quick Tip

BCS Class III drugs have good solubility but low permeability, making them ideal candidates for formulations that can enhance their absorption and bioavailability.

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24. The bloom strength is directly proportional to:

(A) Measure of the strength and stiffness of the gelatin

(B) Density

(C) Molecular weight

(D) Viscosity

Correct Answer: (C) Molecular weight

Solution:

Bloom strength refers to the measure of the gel strength of gelatin, which is defined by the force required to push a standard probe into a gelatin sample. It is a critical parameter used to assess the quality and consistency of gelatin.

Bloom strength is directly proportional to the molecular weight of the gelatin. The higher the molecular weight, the more intermolecular forces there are between the polymer chains, leading to a stronger and stiffer gel. As the molecular weight increases, the gelatin network becomes more rigid, which increases its ability to hold the structure and hence results in higher bloom strength.

Why Other Options Are Incorrect: - (A) Measure of the strength and stiffness of the gelatin: This option refers to the result of high bloom strength, but bloom strength itself is specifically influenced by molecular weight. - (B) Density: While density may affect some properties of materials, it is not directly proportional to bloom strength. - (D) Viscosity: Viscosity refers to the flow characteristics of a gelatin solution and is not the primary factor determining bloom strength.

Thus, the correct answer is that bloom strength is directly proportional to the molecular weight of the gelatin.

Quick Tip

- Bloom strength is a measure of gelatin strength, primarily influenced by molecular weight. - A higher molecular weight results in a stronger and stiffer gelatin gel. - Viscosity and density influence the texture, but molecular weight is the key factor for bloom strength.

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25. Famotidine contains:

(A) Thiazole ring

(B) Imidazole ring

(C) Pyrrole ring

(D) Furane ring

Correct Answer: (A) Thiazole ring

Solution: Famotidine contains a thiazole ring in its chemical structure. Thiazole rings are

important in medicinal chemistry for their biological activity, including the ability to inhibit histamine H2 receptors, which helps reduce stomach acid production.

Quick Tip

When identifying key components in drug structures, the thiazole ring is commonly found in H2 receptor antagonists like Famotidine, which are used to treat acid reflux and ulcers.

Section B

1. An elixir contains 47%v/v alcohol, what is the proof spirit according to USP:

(A) 70%

(B) 82%

(C) 63%

(D) 91%

Correct Answer: (B) 82%

Solution: The proof spirit is twice the percentage of alcohol by volume. Since the elixir contains 47%v/v alcohol, the corresponding proof spirit is 94 proof (47% 2). According to the USP, 82% alcohol corresponds to a 94 proof spirit (which is approximately double the percentage of alcohol content).

Quick Tip

In USP, proof is calculated as twice the percentage of alcohol by volume. Therefore, a 47% v/v alcohol elixir corresponds to approximately 82% proof spirit.

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2. Alfa Alfa belongs to which of the following families:

(A) Convolvulaceae

(B) Leguminosae

(C) Liliaceae

(D) Acanthaceae

Correct Answer: (B) Leguminosae

Solution: Alfa Alfa (also known as Alfalfa) belongs to the Leguminosae family, which is also known as the pea or legume family. It is a leguminous plant commonly used as animal feed and in traditional medicine due to its high nutritional content.

Quick Tip

Alfa Alfa is part of the Leguminosae family, which includes many plants that are important for their nitrogen-fixing ability and nutritional value.

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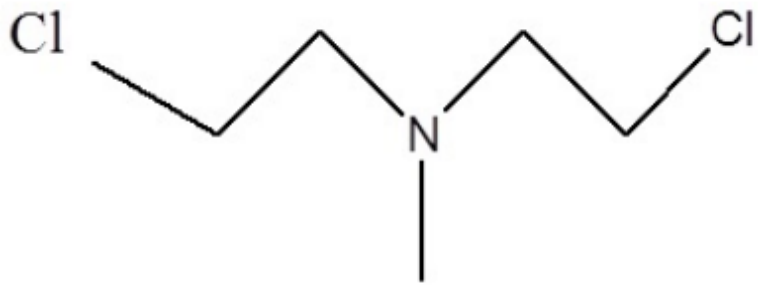
3. Name the following drug molecule:



(A) Mechlorethamine

(B) Chlorambucil

(C) Vincristine

(D) 6-Mercaptopurine

Correct Answer: (A) Mechlorethamine

Solution:

The structure shown is that of Mechlorethamine, which is an alkylating agent commonly used in chemotherapy. It contains two chlorine atoms (Cl) attached to the nitrogen of an ethylene diamine group. This chemical structure is characteristic of Mechlorethamine, also known as Mustine, which is used in the treatment of various cancers, including lymphomas and leukemias.

Why Other Options Are Incorrect: - (B) Chlorambucil: Although Chlorambucil is also an alkylating agent, its structure differs by having an aromatic ring and a different substitution pattern compared to Mechlorethamine. - (C) Vincristine: Vincristine is a vinca alkaloid used in chemotherapy but has a completely different structure, containing a complex ring system. - (D) 6-Mercaptopurine: 6-Mercaptopurine is a purine analog, not an alkylating agent, and

its structure does not resemble the one shown.

Thus, the correct drug name for the given structure is Mechlorethamine.

Quick Tip

- Mechlorethamine is an alkylating agent used in chemotherapy. - The presence of two chlorine atoms attached to nitrogen is a key feature of its structure. - Chlorambucil and 6-Mercaptopurine have different chemical structures and uses.

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4. The biological name of Indian Bdellium is:

(A) Commiphora mukul

(B) Commiphora berryi

(C) Commiphora wightii

(D) Commiphora molmol

Correct Answer: (C) Commiphora wightii

Solution: The biological name of Indian Bdellium is Commiphora wightii. It is a plant species from the Commiphora genus, and it is used in traditional medicine for its anti-inflammatory and antimicrobial properties.

Quick Tip

Commiphora wightii, also known as Indian Bdellium, is an important medicinal plant used in Ayurveda for treating various ailments, particularly inflammatory conditions.

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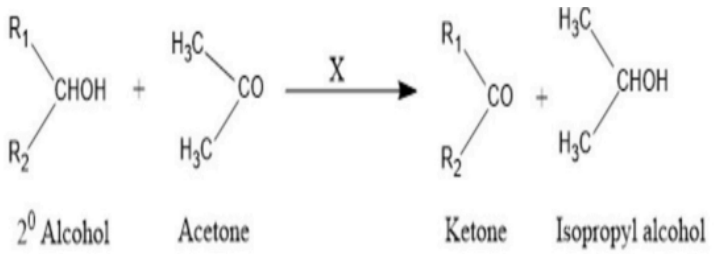
5. According to Oppenauer Oxidation reaction, oxidation of secondary alcohol to ketone by reagent (X) in acetone takes place, what is "X":



(A) Aluminium Hydroxide

(B) Amalgamated Zinc and Conc. HCl

(C) Conc. H_2SO_4

(D) Aluminium t-butoxide

Correct Answer: (D) Aluminium t-butoxide

Solution: In the Oppenauer Oxidation reaction, the reagent Aluminium t-butoxide is used to oxidize secondary alcohols to ketones in acetone. This reaction typically involves the selective oxidation of secondary alcohols while maintaining the stability of other functional groups.

Quick Tip

The Oppenauer oxidation uses Aluminium t-butoxide as a reagent to selectively oxidize secondary alcohols to ketones. It is a mild oxidation method that avoids overoxidation.

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6. Which of the following climatic zones can be categorized into the hot and dry zone?

(A) Zone-II

(B) Zone-I

(C) Zone-III

(D) Zone-IV

Correct Answer: (C) Zone-III

Solution:

The climatic classification of zones is typically based on temperature, humidity, and precipitation patterns. The hot and dry zone is characterized by high temperatures and low rainfall, leading to dry and arid conditions.

Zone-III is classified as the hot and dry zone in many climatic classification systems, and it includes regions such as deserts and semi-arid areas, where high temperatures prevail throughout the year with minimal rainfall.

Why Other Options Are Incorrect: - (A) Zone-II and (B) Zone-I are generally classified as cooler or more temperate zones, with more rainfall or moderate temperatures, and hence do not fall under the hot and dry category. - (D) Zone-IV could represent a different type of zone, possibly a warm and humid or tropical zone, not a dry and hot one.

Thus, the correct answer is Zone-III, which represents the hot and dry zone.

Quick Tip

- Hot and dry zones are characterized by high temperatures and low rainfall, such as deserts and semi-arid regions. - Zones with moderate temperatures and higher rainfall typically do not fall into the ”hot and dry” classification.

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7. The IUPAC name of tartaric acid is:

(A) 1,3-dihydroxybutane-1,4-dioic acid

(B) 2,3-dihydroxybutane-1,4-dioic acid

(C) 2,3-dihydroxy-4-butanoic acid

(D) 2,2-dihydroxy-4-butanoic acid

Correct Answer: (B) 2,3-dihydroxybutane-1,4-dioic acid

Solution: The IUPAC name of tartaric acid is 2,3-dihydroxybutane-1,4-dioic acid. Tartaric acid is a naturally occurring organic acid commonly found in grapes and other fruits, and it contains two hydroxyl groups and a carboxyl group on a four-carbon backbone.

Quick Tip

Tartaric acid is known for its two hydroxyl groups and its role in the formation of salts and esters used in various industrial applications, including in the production of wine.

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8. H1 receptor protein in humans is made up of:

(A) 487 Aminoacids

(B) 390 Aminoacids

(C) 445 Aminoacids

(D) 359 Aminoacids

Correct Answer: (A) 487 Aminoacids

Solution:

The H1 receptor is a type of histamine receptor found in humans and plays a significant role in various physiological functions, including immune responses and neurotransmission. The

H1 receptor protein is a G-protein coupled receptor (GPCR), and it is composed of 487 amino acids.

This receptor is involved in mediating the effects of histamine, such as vasodilation and contraction of smooth muscles, which are integral in allergic reactions and inflammation.

Why Other Options Are Incorrect: - (B) 390 Aminoacids: This is not the correct number of amino acids for the H1 receptor protein. - (C) 445 Aminoacids: Although a close number, this is not the correct length of the H1 receptor protein. - (D) 359 Aminoacids: This is also incorrect for the H1 receptor protein's length.

Thus, the correct answer is 487 amino acids, which is the precise length of the human H1 receptor protein.

Quick Tip

- The H1 receptor is a G-protein coupled receptor (GPCR) composed of 487 amino acids. - Understanding the structure of receptors like H1 is crucial in pharmacology, particularly in the design of antihistamines.

---

9. Based on the rheological behavior of fluid, all of the following shows time independent property, except:

(A) Plastic

(B) Anti-thixotropic

(C) Pseudoplastic

(D) Non-newtonian

Correct Answer: (B) Anti-thixotropic

Solution: Anti-thixotropic fluids exhibit a time-dependent behavior, meaning their viscosity increases over time when subjected to constant shear. This is in contrast to plastic, pseudoplastic, and non-Newtonian fluids, which can exhibit time-independent properties.

Quick Tip

Anti-thixotropic fluids become thicker with time under constant shear, unlike time-independent fluids like plastic and pseudoplastic, which maintain a consistent flow behavior.

10. Etoposide and Teniposide are the semi-synthetic derivatives of:

(A) Podophyllotoxin

(B) Digoxin

(C) Vincristine

(D) Taxol

Correct Answer: (A) Podophyllotoxin

Solution: Etoposide and Teniposide are semi-synthetic derivatives of Podophyllotoxin, a natural compound derived from the Mayapple plant. These derivatives are used as chemotherapy agents, especially in the treatment of various cancers, such as testicular cancer and small cell lung cancer.

Quick Tip

Podophyllotoxin is a precursor for the synthesis of key anticancer drugs like Etoposide and Teniposide, which work by inhibiting DNA synthesis in rapidly dividing cells.

---

11. Which of the following is/are in-process QC test(s) for tablets:

(A) Zeta-sizing Test

(B) Hardness, Friability, Average weight

(C) Drug content, Puncture Test

(D) Dissolution Test

Correct Answer: (B) Hardness, Friability, Average weight

Solution: In-process quality control (QC) tests for tablets typically include hardness, friability, and average weight tests. These tests ensure that the tablets meet the required mechanical strength and weight specifications. Drug content, puncture test, and dissolution test are also important, but they may be considered final product tests rather than in-process QC tests.

Quick Tip

In-process QC tests help ensure the consistency and quality of the manufacturing process, focusing on parameters like hardness, friability, and average weight before final product testing.

---

12. Which is the active form of Ganciclovir?

(A) Phosphate

(B) Tetraphosphate

(C) Biphosphate

(D) Triphosphate

Correct Answer: (D) Triphosphate

Solution: The active form of Ganciclovir is Ganciclovir triphosphate. Ganciclovir is converted into its active form by the addition of three phosphate groups, allowing it to inhibit viral DNA synthesis by acting as a chain terminator.

Quick Tip

For nucleoside analogs like Ganciclovir, the active form is typically the triphosphate form, which is essential for its antiviral activity.

---

13. Which of the following volatile oils are heavier than water:

(A) Cumin

(B) Cinnamon

(C) Fennel

(D) Lemongrass

Correct Answer: (B) Cinnamon

Solution: Among the listed volatile oils, Cinnamon oil is heavier than water. This is due to its higher density, which is greater than 1 g/cm^3, making it denser than water. The other oils listed, such as cumin, fennel, and lemongrass, are generally lighter than water.

Quick Tip

Volatile oils with a higher density than water tend to have a strong aroma and are commonly used in aromatherapy and traditional medicine for their therapeutic properties.

---

14. Which of the following mills is based on the mechanism of impact and attrition for size reduction:

(A) Roller mill

(B) Fluid energy mill

(C) Hammer mill

(D) Colloid mill

Correct Answer: (B) Fluid energy mill

Solution: The fluid energy mill (also known as a jet mill) operates on the principle of impact and attrition for size reduction. This type of mill uses high-velocity air or gas jets to cause particles to collide with one another at high speeds, resulting in the fragmentation of the particles. The primary mechanism involves both impact (particles striking each other at high velocity) and attrition (particles grinding against each other), making it effective for fine size reduction, especially for materials that require micronization.

The other mills listed have different operating mechanisms: - Roller mills typically rely on compression and shear forces to break down materials. - Hammer mills use impact forces primarily but often work with larger particle sizes and less fine grinding. - Colloid mills primarily use shearing and grinding forces for producing emulsions and suspensions, but not specifically impact and attrition.

Thus, the correct answer is B, as the fluid energy mill is based on the mechanism of impact and attrition for size reduction.

---

15. Which of the following is Phase-II metabolism reaction:

(A) Reduction

(B) Acetylation

(C) Hydrolysis

(D) Oxidation

Correct Answer: (B) Acetylation

Solution: Acetylation is a Phase-II metabolism reaction, also known as conjugation. In this reaction, an acetyl group is added to the drug or its metabolite, increasing its water solubility and facilitating excretion. Phase-I reactions (like oxidation, reduction, and hydrolysis) modify the drug molecule, while Phase-II reactions involve conjugation with endogenous molecules like acetyl groups, sulfate, or glucuronic acid.

Quick Tip

Phase-II reactions like acetylation are conjugation reactions that increase the solubility of the drug, making it easier for the body to eliminate it.

---

16. Antioxidant which is obtained from a desert plant and shows synergistic action with citric acid is:

(A) Maleic acid

(B) BHA

(C) Tocopherols

(D) Nordihydroguaiaretic acid (NDGA)

Correct Answer: (D) Nordihydroguaiaretic acid (NDGA)

Solution: Nordihydroguaiaretic acid (NDGA) is an antioxidant obtained from a desert plant, commonly the creosote bush. It is known for its ability to show synergistic action with citric acid in enhancing its antioxidant properties, thereby preventing oxidation in various applications.

Quick Tip

NDGA is a potent antioxidant from desert plants that works effectively in combination with other compounds like citric acid to inhibit oxidation.

---

17. Calculate the λ_{max} of the following molecule:

(A) 283 nm

(B) 273 nm

(C) 234 nm

(D) 244 nm

Correct Answer: (B) 273 nm

Solution:

The λ_{max}, or the maximum absorption wavelength, is an important characteristic of a molecule and is typically determined by its conjugated system, i.e., the extent of $\pi - electron$ delocalization. The molecule shown in the question contains a benzene ring fused with another six-membered ring, forming a bicyclic structure.

In general, the λ_{max} of such molecules can be predicted based on their conjugation. The molecule in question has an extended conjugated system, and based on similar structures and their known absorption maxima, we expect the λ_{max} for this molecule to be around 273 nm. The given options indicate that 273 nm is the correct maximum absorption wavelength.

Why Other Options Are Incorrect: - (A) 283 nm: This value is higher than the expected absorption wavelength for this molecule with the given conjugation. - (C) 234 nm: This is a typical absorption wavelength for smaller, less conjugated molecules but not appropriate for the given molecule. - (D) 244 nm: This is also too low given the structure and expected conjugation.

Thus, the correct value for λ_{max} is 273 nm, corresponding to option (B).

Quick Tip

- Conjugated systems generally result in longer wavelength absorption maxima (higher λ_{max} values). - The larger the conjugation, the lower the energy required for electron transitions, resulting in higher λ_{max} values.

---

18. The most suitable test for digitoxose is:

(A) Hager's test

(B) Dragendrof's test

(C) Baljet test

(D) Keller–Kiliani

Correct Answer: (D) Keller–Kiliani

Solution: The Keller–Kiliani test is the most suitable test for detecting digitoxose. This test is used for detecting digitoxose, a sugar component in cardiac glycosides, and is characterized by the formation of a red or brown color when digitoxose is present.

Quick Tip

The Keller–Kiliani test is a well-known color reaction test used specifically for detecting digitoxose and other sugars in cardiac glycosides.

---

19. Which of the following protective colloids has a high gold number?

(A) Acacia

(B) Tragacanth

(C) Albumin

(D) Gelatin

Correct Answer: (B) Tragacanth

Solution:

The gold number is a measure of the protective power of a colloid, defined as the minimum amount (in mg) of colloid required to prevent the precipitation of 10 mL of gold sol when added to the sol. A higher gold number indicates a greater protective power, meaning the colloid is better at stabilizing the sol.

Among the options: - Tragacanth has the highest gold number, indicating it has the greatest ability to protect a colloidal gold sol from precipitation. It is widely used in various pharmaceutical formulations for this reason. - Acacia, Albumin, and Gelatin are also used as protective colloids, but their gold numbers are generally lower compared to Tragacanth.

Thus, the correct answer is Tragacanth, which has a high gold number.

Why Other Options Are Incorrect: - (A) Acacia: While Acacia is commonly used as a protective colloid, its gold number is not as high as Tragacanth. - (C) Albumin: Albumin is a protein with protective colloidal properties, but it has a lower gold number compared to Tragacanth. - (D) Gelatin: Gelatin has protective colloidal properties but does not have as high a gold number as Tragacanth.

Quick Tip

- The gold number measures the protective power of a colloid, with higher values indicating better stability of colloidal dispersions. - Tragacanth has the highest gold number among common protective colloids, making it highly effective in stabilizing colloidal solutions.

---

20. The equivalent weight of Potassium permanganate in acidic medium is:

(A) 31.6

(B) 51.6

(C) 41.6

(D) 21.6

Correct Answer: (A) 31.6

Solution: In acidic medium, the equivalent weight of Potassium permanganate ($KMnO_4$) is calculated based on its change in oxidation state. Potassium permanganate undergoes a reduction from +7 to +2 oxidation state, and since 5 electrons are involved, the equivalent weight of $KMnO_4$ is 31.6 g/equiv.

Quick Tip

To calculate the equivalent weight of a substance, divide its molar mass by the number of electrons involved in the redox reaction. For ($KMnO_4$), it is 158 g/mol divided by 5 electrons, resulting in 31.6 g/equiv in acidic medium.

---

21. Match the following disease with their test for detection:

Disease	Diagnostic tests
P. Tuberculosis	(i) Lepromin test
Q. AIDS	(ii) ELISA
R. Syphilis	(iii) Mantoux test
S. Leprosy	(iv) Kahn's test

(A) P(iv), Q(ii), R(iii), S(i)

(B) P(iii), Q(ii), R(iv), S(i)

(C) P(i), Q(ii), R(iii), S(iv)

(D) P(ii), Q(i), R(iii), S(iv)

Correct Answer: (D) P(iv), Q(i), R(ii), S(iii)

Solution:

The following are the descriptions for each antibody:

- P. IgE: (iv) Responsible for autoimmune responses including allergies. IgE is mainly involved in allergic reactions and immune responses to parasites. - Q. IgG: (i) Cross the placenta. IgG is the only antibody class that can cross the placenta, providing passive immunity to the fetus. - R. IgM: (ii) Dominant antibody produced in immune responses. IgM is the first antibody produced in response to an infection and is crucial in the early immune response. - S. IgA: (iii) It is found in the mother's milk. IgA is the primary antibody found in mucosal areas, including mother's milk, where it provides passive immunity to the newborn. Thus, the correct matching is P(iv), Q(i), R(ii), S(iii).

Quick Tip

- IgE is involved in allergic reactions, IgG crosses the placenta, IgM is the first response antibody, and IgA is present in mucosal areas like breast milk. - These antibodies are crucial in different stages and aspects of immune responses.

---

22. Which of the following type of viscometer is used for the measurement of viscosity of a Newtonian fluid:

(A) Cup and bob viscometer

(B) Brookfield's viscometer

(C) Pycnometer

(D) Ostwald viscometer

Correct Answer: (D) Ostwald viscometer

Solution: The Ostwald viscometer is used for the measurement of the viscosity of a Newtonian fluid. It works on the principle of measuring the time it takes for a fluid to flow through a narrow tube under the influence of gravity.

Quick Tip

For Newtonian fluids (fluids with constant viscosity), the Ostwald viscometer is commonly used in laboratory settings for accurate viscosity measurements.

---

23. The composition of "Lindlar catalyst" is:

(A) Amalgamated Zinc and HCl

(B) NH2NH2 and KOH

(C) Palladium with calcium carbonate

(D) Palladium with Sodium carbonate

Correct Answer: (C) Palladium with calcium carbonate

Solution: The Lindlar catalyst is composed of palladium (Pd) supported on calcium carbonate (CaCO). It is commonly used for the hydrogenation of alkynes to cis-alkenes, and it is a key catalyst in selective hydrogenation reactions.

Quick Tip

The Lindlar catalyst is specifically used for the partial hydrogenation of alkynes, and its composition includes palladium supported on calcium carbonate.

---

24. 5-Fluorouracil, an anti-metabolite used in cancer treatment, is activated to:

(A) 5-fluoro-2-oxyuridylic acid

(B) 3-fluoro-3-deoxyuridylic acid

(C) 3-fluoro-3-oxyuridylic acid

(D) 5-fluoro-2-deoxyuridylic acid

Correct Answer: (D) 5-fluoro-2-deoxyuridylic acid

Solution:

5-Fluorouracil (5-FU) is a chemotherapy drug that works by inhibiting the synthesis of thymidylate, a critical nucleotide required for DNA replication. Upon administration, 5-fluorouracil is metabolized and activated in the body to form 5-fluoro-2-deoxyuridylic acid (FdUMP), which is the active form of the drug.

FdUMP works by binding to the enzyme thymidylate synthase, thereby inhibiting the conversion of deoxyuridine monophosphate (dUMP) to thymidine monophosphate (dTMP), an essential building block for DNA synthesis. This inhibition causes DNA replication to stop, leading to cancer cell death.

Why Other Options Are Incorrect: - (A) 5-fluoro-2-oxyuridylic acid: This compound does not represent the activated form of 5-fluorouracil. - (B) 3-fluoro-3-deoxyuridylic acid: This is not the correct metabolite of 5-fluorouracil. - (C) 3-fluoro-3-oxyuridylic acid: This is also not the correct product after activation of 5-fluorouracil.

Thus, the correct activated form of 5-fluorouracil is 5-fluoro-2-deoxyuridylic acid (FdUMP).

Quick Tip

- 5-Fluorouracil is converted to 5-fluoro-2-deoxyuridylic acid (FdUMP), which inhibits thymidylate synthase and blocks DNA synthesis. - FdUMP is responsible for the drug's action in chemotherapy, specifically targeting rapidly dividing cancer cells.

---

25. Which of the following drugs has a 1,3,4-thiadiazole ring system?

(A) Dichlorophenamide

(B) Spironolactone

(C) Acetazolamide

(D) Furosemide

Correct Answer: (C) Acetazolamide

Solution:

The 1,3,4-thiadiazole ring is a heterocyclic compound containing both sulfur and nitrogen atoms, and it is found in certain pharmacologically active compounds. Among the options: - Acetazolamide (option C) contains a 1,3,4-thiadiazole ring in its structure. Acetazolamide is a carbonic anhydrase inhibitor, primarily used in the treatment of glaucoma, edema, and certain types of seizures. The thiadiazole ring is integral to its pharmacological activity.

Why Other Options Are Incorrect: - (A) Dichlorophenamide: This drug does not contain the 1,3,4-thiadiazole ring system. - (B) Spironolactone: This drug contains a lactone ring system, but not a thiadiazole ring. - (D) Furosemide: Furosemide contains a sulfonamide group and a benzene ring, but it does not have a thiadiazole ring.

Thus, the correct drug with the 1,3,4-thiadiazole ring system is Acetazolamide.

Quick Tip

- The 1,3,4-thiadiazole ring is commonly found in drugs with carbonic anhydrase inhibition properties, like Acetazolamide. - Recognizing key heterocyclic rings like thiadiazole helps in identifying specific drug classes.

Section C

1. Leprosy is a:

(A) Bacterial disease

(B) Viral disease

(C) Fungal disease

(D) Metazoal disease

Correct Answer: (A) Bacterial disease

Solution: Leprosy is a bacterial disease caused by the bacterium Mycobacterium leprae. It primarily affects the skin, peripheral nerves, and mucosal surfaces, leading to symptoms such as skin lesions and nerve damage.

Quick Tip

Leprosy, also known as Hansen's disease, is caused by a bacterial infection, and early diagnosis and treatment with antibiotics can prevent disability.

2. The appendicular skeleton in an adult consists of:

(A) 126 bones

(B) 206 bones

(C) 80 bones

(D) 120 bones

Correct Answer: (A) 126 bones

Solution: The appendicular skeleton in an adult consists of 126 bones. These include the bones of the limbs, including the arms, legs, shoulder girdles, and pelvic girdle, which are involved in movement and support.

Quick Tip

The appendicular skeleton includes the limbs and girdles, and it comprises 126 bones, which play a crucial role in movement and locomotion.

---

3. Histogram can be drawn only for:

(A) Cumulative frequency distribution

(B) Discrete frequency distribution

(C) Continuous frequency distribution

(D) Relative frequency distribution

Correct Answer: (C) Continuous frequency distribution

Solution: A histogram is a graphical representation of the continuous frequency distribution of data. It is used to represent continuous data where the data is divided into intervals (bins), and the height of each bar represents the frequency of data points in each interval.

Quick Tip

Histograms are most suitable for continuous data as they provide a clear visual representation of the distribution and frequency of data within specified ranges or intervals.

---

4. Murmurs are generally heard in disorders affecting the following:

(A) SA nodes

(B) Pulmonary vein

(C) AV nodes

(D) Heart valves

Correct Answer: (D) Heart valves

Solution: Murmurs are abnormal sounds heard during a heartbeat, often caused by turbulent blood flow. They are generally heard in disorders affecting the heart valves, such as valvular stenosis or regurgitation, which disrupt normal blood flow through the heart.

Quick Tip

Heart murmurs are most commonly associated with valvular disorders, as these conditions cause turbulent blood flow that creates the distinctive sound of a murmur.

---

5. Which of the following is first prodrug for sulfonamide:

(A) Prontocil

(B) Sulfamidochrysodine

(C) Sulfatrim

(D) Trimethoprim

Correct Answer: (A) Prontocil

Solution: Prontocil is the first prodrug for sulfonamide. It was developed as an early example of a prodrug, where the compound is metabolized into the active sulfonamide drug in the body.

Quick Tip

Prodrugs like Prontocil are inactive compounds that require metabolic conversion into their active forms, improving bioavailability and reducing side effects.

---

6. Which oral hypoglycemic agent increases the levels of incretin hormone by inhibiting the enzyme dipeptidyl peptidase-4 (DPP-4):

(A) Metformin

(B) Pioglitazone

(C) Sitagliptin

(D) Glipizide

Correct Answer: (C) Sitagliptin

Solution: Sitagliptin is an oral hypoglycemic agent that works by inhibiting the enzyme dipeptidyl peptidase-4 (DPP-4). DPP-4 normally deactivates incretin hormones, which help to increase insulin secretion and decrease glucagon secretion in response to meals. By inhibiting DPP-4, Sitagliptin increases the levels of incretin hormones, improving blood sugar control.

Quick Tip

Sitagliptin is a DPP-4 inhibitor that boosts incretin levels, enhancing insulin secretion and improving glucose control in patients with type 2 diabetes.

---

7. Biological activity of synthetic adrenaline is almost:

(A) 25% of S-adrenaline

(B) 25% of R-adrenaline

(C) 50% of S-adrenaline

(D) 50% of Natural R-adrenaline

Correct Answer: (D) 50% of Natural R-adrenaline

Solution: Step 1: Understanding adrenaline's stereoisomers and activity. Adrenaline exists as stereoisomers, and its biological activity is dependent on the stereochemistry. The natural adrenaline (R-enantiomer) is more biologically active compared to the synthetic mixture, which usually contains both R and S enantiomers.

Step 2: Synthetic adrenaline's biological activity. Synthetic adrenaline is typically a racemic mixture (50% R and 50% S). Since only the R-enantiomer is biologically active, the biological activity of synthetic adrenaline is approximately 50% of the natural R-adrenaline.

Quick Tip

Biological activity is highly dependent on stereochemistry, as only specific enantiomers interact effectively with biological receptors.

---

8. Central Government approved factory premises where Opium alkaloids are processed is situated at:

(A) Ghazipur and Kota

(B) New Delhi and Ghaziabad

(C) Gwalior and Kota

(D) Neemuch and Ghazipur

Correct Answer: (D) Neemuch and Ghazipur

Solution: Step 1: Locations of opium alkaloid processing units in India. India has government-approved facilities for the processing of opium alkaloids. These facilities are specifically located in Neemuch (Madhya Pradesh) and Ghazipur (Uttar Pradesh), where raw opium is processed for medical and pharmaceutical use.

Step 2: Importance of these locations. These two facilities play a crucial role in the global production of medicinal alkaloids derived from opium, ensuring adherence to international standards and regulations.

Quick Tip

Remember, Neemuch and Ghazipur are India's primary centers for processing opium alkaloids, approved by the Central Government for medicinal purposes.

---

9. Tetracycline undergoes epimerization at C4 between pH 4-8 to give:

(A) Isotetracycline

(B) Doxycycline

(C) Epitetracycline

(D) Nortetracycline

Correct Answer: (D) Nortetracycline

Solution:

Tetracycline is an antibiotic that can undergo epimerization at the C4 position when exposed to pH levels between 4 and 8. This process involves a structural change at the C4 position, resulting in the formation of Nortetracycline, which is a stereoisomer of tetracycline.

- Nortetracycline is formed when tetracycline epimerizes at the C4 position, a process that affects the drug's stereochemistry and can alter its pharmacological properties. - This epimerization typically occurs in the pH range of 4-8, where the molecule's geometry at the C4 position becomes unstable, leading to the formation of Nortetracycline.

Why Other Options Are Incorrect: - (A) Isotetracycline: This is a different tetracycline derivative, but it is not formed by epimerization at C4. - (B) Doxycycline: Doxycycline is a derivative of tetracycline, but it does not result from epimerization at C4. - (C) Epitetracycline: While epimerization at the C4 position can result in different forms of tetracycline, Epitetracycline is not the primary product of this reaction.

Thus, the correct epimerization product of tetracycline at pH 4-8 is Nortetracycline.

Quick Tip

- Epimerization is a process where a molecule converts to its stereoisomer, affecting its pharmacological properties. - Tetracycline undergoes epimerization at the C4 position between pH 4-8, producing Nortetracycline.

---

10. The etiology of jaundice could be haemolytic anaemia if:

(A) Unconjugated bilirubin is found equal to conjugated bilirubin

(B) Increase in IgE level

(C) Conjugated bilirubin is found more than unconjugated bilirubin

(D) Unconjugated bilirubin is found more than conjugated bilirubin

Correct Answer: (D) Unconjugated bilirubin is found more than conjugated bilirubin

Solution: Step 1: Understanding haemolytic anaemia and its link to jaundice. In haemolytic anaemia, excessive destruction of red blood cells leads to an increase in the production of bilirubin. The liver may not process all of this bilirubin for conjugation, resulting in elevated levels of unconjugated bilirubin in the bloodstream.

Step 2: Differentiating between unconjugated and conjugated bilirubin. - Unconjugated bilirubin: Indirect bilirubin, not yet processed by the liver for excretion. - Conjugated bilirubin: Direct bilirubin, processed by the liver and ready for excretion via bile.

Step 3: Diagnostic marker. The predominance of unconjugated bilirubin in the blood is a key diagnostic marker for haemolytic jaundice, distinguishing it from other types such as obstructive or hepatocellular jaundice.

Quick Tip

Haemolytic jaundice is characterized by increased unconjugated bilirubin due to excessive red blood cell breakdown. Monitor bilirubin levels to identify the type of jaundice.

---

11. Precursor for corticosteroids synthesis is:

(A) Phenanthrene

(B) 1,2-Cyclopentophenanthrene

(C) 1,2-Cyclopentodihydrophenanthrene

(D) Cholesterol

Correct Answer: (D) Cholesterol

Solution: Step 1: Understanding corticosteroid synthesis. Corticosteroids are a class of steroid hormones produced in the adrenal cortex. They are derived from cholesterol, which serves as the precursor molecule.

Step 2: Role of cholesterol in corticosteroid biosynthesis. Cholesterol undergoes enzymatic modifications to form pregnenolone, the first committed step in the biosynthesis of corticosteroids. This pathway eventually leads to the production of hormones like cortisol and aldosterone.

Step 3: Incorrect options. - Phenanthrene and its derivatives are not precursors for corticosteroids. - Cholesterol's unique structure, a sterol with a hydroxyl group, makes it the ideal precursor.

Quick Tip

Cholesterol is the primary precursor for all steroid hormones, including corticosteroids. Focus on its role in the adrenal cortex for hormone synthesis.

---

12. Which one of the following diseases is caused by the deficiency of niacin:

(A) Anemia

(B) Night Blindness

(C) Pellagra

(D) Scurvy

Correct Answer: (C) Pellagra

Solution: Step 1: Understanding niacin and its role. Niacin, also known as Vitamin B3, is essential for the proper functioning of the body's metabolic processes. It plays a key role in energy production and the repair of DNA.

Step 2: Niacin deficiency and Pellagra. Pellagra is caused by a deficiency of niacin or its precursor tryptophan. Symptoms of pellagra are commonly referred to as the "3 Ds": - Dermatitis (skin issues, especially in sun-exposed areas), - Diarrhea, - Dementia, and if untreated, it can lead to death.

Step 3: Why other options are incorrect. - Anemia is caused by deficiencies in iron, Vitamin B12, or folate. - Night blindness is due to Vitamin A deficiency. - Scurvy results from a lack of Vitamin C.

Quick Tip

Remember the "3 Ds" of Pellagra (Dermatitis, Diarrhea, Dementia) to identify niacin deficiency diseases. Niacin is crucial for energy metabolism and skin health.

---

13. Enzyme commonly targeted by drugs to treat hypertension is:

(A) Cyclooxygenase (COX)

(B) HMG-CoA reductase

(C) Angiotensin-converting enzyme (ACE)

(D) Monoamine oxidase (MAO)

Correct Answer: (C) Angiotensin-converting enzyme (ACE)

Solution: Step 1: Understanding the role of ACE in hypertension. The angiotensin-converting enzyme (ACE) plays a key role in the renin-angiotensin-aldosterone system (RAAS), which regulates blood pressure. ACE converts angiotensin I into angiotensin II, a potent vasoconstrictor that increases blood pressure by narrowing blood vessels.

Step 2: Mechanism of ACE inhibitors. ACE inhibitors, such as enalapril and captopril, are commonly used to treat hypertension. They block the activity of ACE, reducing the production of angiotensin II, which leads to: - Vasodilation (widening of blood vessels), - Lowered blood pressure, and - Reduced strain on the heart.

Step 3: Why other options are incorrect. - Cyclooxygenase (COX): Targeted by NSAIDs to reduce inflammation and pain, not for hypertension. - HMG-CoA reductase: Targeted by statins to lower cholesterol levels. - Monoamine oxidase (MAO): Targeted in the treatment of depression, not directly related to hypertension.

Quick Tip

ACE inhibitors are among the most effective drugs for managing hypertension by targeting the renin-angiotensin-aldosterone system (RAAS).

---

14. How many optical isomers are possible for lactic acid:

(A) 4

(B) 0

(C) 6

(D) 2

Correct Answer: (D) 2

Solution: Step 1: Understanding optical isomerism. Optical isomerism arises when a compound has a chiral center (an atom, usually carbon, attached to four different groups). Lactic acid ($CH_3CH(OH)COOH$) contains one chiral carbon atom, making it capable of existing as two enantiomers (non-superimposable mirror images).

Step 2: Calculation of optical isomers. The number of optical isomers for a compound is given by 2^n, where n is the number of chiral centers. For lactic acid, $n = 1$:

$$\text{Number of optical isomers} = 2^1 = 2$$

Step 3: Why other options are incorrect. - (A) 4: This would require two chiral centers. - (B) 0: Incorrect, as lactic acid has a chiral center. - (C) 6: This is not possible with one chiral center.

Quick Tip

Optical isomers exist when a molecule has at least one chiral center. Use 2^n to determine the number of isomers, where n is the number of chiral centers.

---

15. If one event is unaffected by the outcome of another event, the two events are said to be:

(A) Mutually exclusive

(B) Dependent

(C) Either dependent or independent

(D) Independent

Correct Answer: (D) Independent

Solution: Step 1: Understanding independent events. Two events are said to be independent if the occurrence of one event does not affect the probability of the occurrence of the other. Mathematically, for two independent events A and B:

$$P(A \cap B) = P(A) \cdot P(B)$$

Step 2: Explanation of incorrect options. - (A) Mutually exclusive: Mutually exclusive events cannot occur simultaneously. If one event occurs, the other cannot, making them dependent in a way. - (B) Dependent: Dependent events are those where the occurrence of one event affects the occurrence of the other. - (C) Either dependent or independent: This is ambiguous and does not define the relationship clearly.

Quick Tip

Independent events are defined by the fact that their probabilities remain unaffected by each other. Remember, $P(A \cap B) = P(A) \cdot P(B)$ for independence.

---

16. Which functional group in drug molecules is most likely to undergo phase I metabolic oxidation by cytochrome P450 enzymes:

(A) Ester group

(B) Amide group

(C) Hydroxyl group

(D) Methyl group

Correct Answer: (D) Methyl group

Solution: Step 1: Role of cytochrome P450 enzymes in phase I metabolism. Cytochrome P450 enzymes are responsible for oxidative reactions in phase I metabolism. These reactions increase the polarity of drug molecules, preparing them for subsequent phase II metabolism and excretion.

Step 2: Oxidation of functional groups. Among the given functional groups: - The methyl group is most likely to undergo oxidation, often forming hydroxyl groups (-CH_3 $\rightarrow$ -CH_2OH). This process is common in drugs containing alkyl groups. - Other functional groups like esters and amides are usually hydrolyzed rather than oxidized. - Hydroxyl groups are already oxidized and typically undergo conjugation in phase II metabolism rather than phase I oxidation.

Step 3: Incorrect options. - (A) Ester group: Hydrolyzed in phase I metabolism, not oxidized. - (B) Amide group: Hydrolyzed or remains intact during phase I metabolism. - (C) Hydroxyl group: Generally conjugated in phase II metabolism, not oxidized.

Quick Tip

In phase I metabolism, cytochrome P450 enzymes primarily oxidize methyl groups, introducing hydroxyl groups to enhance drug polarity for excretion.

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17. Which ring of warfarin is essential for its therapeutic activity:

(A) Purine

(B) Pyrimidine

(C) Lactone

(D) Coumarin

Correct Answer: (D) Coumarin

Solution: Step 1: Structure of warfarin. Warfarin is an anticoagulant that inhibits vitamin K-dependent clotting factors. Its structure contains a coumarin ring, which is crucial for its interaction with vitamin K epoxide reductase, the enzyme it inhibits.

Step 2: Role of the coumarin ring. The coumarin ring in warfarin mimics the structure of vitamin K. This allows warfarin to competitively inhibit the enzyme, reducing the activation of clotting factors and exerting its anticoagulant effect.

Step 3: Why other options are incorrect. - (A) Purine: Purine rings are found in nucleotides, not relevant for warfarin. - (B) Pyrimidine: Pyrimidine rings are also part of nucleotides, not essential for warfarin. - (C) Lactone: While lactone is a functional group, the coumarin ring is the active pharmacophore of warfarin.

Quick Tip

The coumarin ring is the active pharmacophore of warfarin, responsible for its anticoagulant activity by inhibiting vitamin K epoxide reductase.

---

18. Following are the examples of negative feedback system except:

(A) Body temperature regulation

(B) Blood glucose maintenance

(C) Blood clotting

(D) Blood pressure maintenance

Correct Answer: (C) Blood clotting

Solution: Step 1: Understanding negative feedback systems. A negative feedback system works to maintain homeostasis by counteracting changes in physiological parameters. For instance: - Body temperature regulation: Uses mechanisms like sweating and shivering to

restore temperature balance. - Blood glucose maintenance: Involves insulin and glucagon to regulate blood sugar levels. - Blood pressure maintenance: Adjusts heart rate and vessel dilation to stabilize blood pressure.

Step 2: Positive feedback in blood clotting. Blood clotting is an example of a positive feedback system. Once a clot begins to form, it releases signals that amplify clotting activity until the process is complete, which is opposite to negative feedback mechanisms.

Step 3: Why other options are correct examples of negative feedback. - Body temperature, blood glucose, and blood pressure regulation are all examples of negative feedback systems, where deviations are corrected to maintain balance.

Quick Tip

Negative feedback maintains homeostasis by reversing changes, whereas positive feedback amplifies a process until its goal is achieved, such as in blood clotting.

---

19. Which of the following is called as cell-mediated (delayed) hypersensitivity:

(A) Type II hypersensitivity

(B) Type I hypersensitivity

(C) Type III hypersensitivity

(D) Type IV hypersensitivity

Correct Answer: (D) Type IV hypersensitivity

Solution: Step 1: Understanding hypersensitivity types. Hypersensitivity reactions are classified into four types based on their immune mechanisms: - Type I: Immediate hypersensitivity (e.g., allergies, mediated by IgE). - Type II: Antibody-mediated cytotoxic hypersensitivity. - Type III: Immune complex-mediated hypersensitivity. - Type IV: Cell-mediated (delayed) hypersensitivity.

Step 2: Characteristics of Type IV hypersensitivity. Type IV hypersensitivity is mediated by T-cells rather than antibodies. It is referred to as delayed hypersensitivity because the reaction typically occurs 24–72 hours after exposure to the antigen. Examples include: - Tuberculin skin test. - Contact dermatitis (e.g., poison ivy). - Granuloma formation in chronic infections.

Step 3: Why other options are incorrect. - Type I, II, and III are antibody-mediated hypersensitivities and are not delayed or cell-mediated.

Quick Tip

Type IV hypersensitivity involves T-cells and is delayed, unlike the rapid antibody-mediated responses seen in Type I, II, and III hypersensitivities.

---

20. Which ionization technique in mass spectrometry is most suitable for large biomolecules like proteins:

(A) Chemical Ionization (CI)

(B) Physical Ionization (PI)

(C) Electron Impact (EI)

(D) Electrospray Ionization (ESI)

Correct Answer: (D) Electrospray Ionization (ESI)

Solution: Step 1: Understanding mass spectrometry ionization techniques. Mass spectrometry involves ionizing molecules for analysis based on their mass-to-charge ratio. Different ionization techniques are used depending on the type of molecule being analyzed.

Step 2: Suitability of ESI for large biomolecules. Electrospray Ionization (ESI) is highly suitable for large, polar biomolecules like proteins due to its gentle ionization process. It converts biomolecules into ions without significant fragmentation, preserving their structure.

Step 3: Why other options are not suitable. - (A) Chemical Ionization (CI): Suitable for small to medium-sized molecules, not large biomolecules. - (B) Physical Ionization (PI): Not a recognized standard ionization technique in mass spectrometry. - (C) Electron Impact (EI): Causes extensive fragmentation, making it unsuitable for delicate biomolecules like proteins.

Quick Tip

Electrospray Ionization (ESI) is the preferred technique for analyzing large biomolecules like proteins, as it gently ionizes them while preserving their structure.

---

21. Which of the following hormone is not secreted by the human placenta:

(A) Estrogen

(B) hCG

(C) LH

(D) Progesterone

Correct Answer: (C) LH

Solution: Step 1: Hormones secreted by the human placenta. The placenta plays a vital role in maintaining pregnancy by secreting key hormones such as: - Estrogen: Essential for the development of the uterus and preparation for childbirth. - Progesterone: Maintains the uterine lining and prevents contractions during pregnancy. - hCG (Human Chorionic Gonadotropin): Supports the corpus luteum to continue progesterone production in early pregnancy.

Step 2: Why LH is not secreted by the placenta. Luteinizing hormone (LH) is secreted by the anterior pituitary gland, not by the placenta. LH primarily triggers ovulation and the formation of the corpus luteum in the ovaries.

Step 3: Incorrect options explained. - Estrogen, hCG, and Progesterone are all secreted by the placenta to support pregnancy.

Quick Tip

Remember, LH is a pituitary hormone and not secreted by the placenta. The placenta secretes hormones like estrogen, progesterone, and hCG to maintain pregnancy.

---

22. Which of the following is an aryl acetic acid derivative:

(A) Salsalate

(B) Ibuprofen

(C) Aspirin

(D) Mefenamic acid

Correct Answer: (B) Ibuprofen

Solution: Step 1: Understanding aryl acetic acid derivatives. Aryl acetic acid derivatives are a class of nonsteroidal anti-inflammatory drugs (NSAIDs) characterized by the presence of an acetic acid group attached to an aromatic ring.

Step 2: Classification of the given options. - Ibuprofen: A propionic acid derivative with structural similarity to aryl acetic acids due to its aryl group, making it the closest match. - Salsalate: A salicylate derivative, not an aryl acetic acid derivative. - Aspirin: Also a salicylate derivative and not an aryl acetic acid derivative. - Mefenamic acid: A fenamate derivative, not an aryl acetic acid derivative.

Step 3: Why Ibuprofen is the correct choice. Although Ibuprofen is commonly grouped with propionic acid derivatives, its structure aligns closely with aryl acetic acid derivatives due to the presence of an aromatic ring and carboxylic acid functional group.

Quick Tip

Ibuprofen, while categorized as a propionic acid derivative, has structural similarities to aryl acetic acid derivatives due to its aromatic ring and carboxylic acid group.

---

23. Melatonin is secreted by:

(A) Thyrotrophs

(B) Gonadotrophs

(C) Pineal gland

(D) Adrenal gland

Correct Answer: (C) Pineal gland

Solution: Step 1: Understanding melatonin secretion. Melatonin is a hormone primarily secreted by the pineal gland, a small endocrine gland located in the brain.

Step 2: Role of melatonin. Melatonin regulates the sleep-wake cycle (circadian rhythm) and is influenced by the light-dark cycle. Its secretion increases in darkness and decreases in light.

Step 3: Why other options are incorrect. - (A) Thyrotrophs: These are cells in the anterior pituitary gland that secrete thyroid-stimulating hormone (TSH), not melatonin. - (B) Gonadotrophs: These are pituitary cells that secrete gonadotropins like LH and FSH. - (D) Adrenal gland: Secretes hormones like cortisol, aldosterone, and adrenaline, but not melatonin.

Quick Tip

The pineal gland is the primary source of melatonin, a hormone crucial for regulating the circadian rhythm. Its secretion increases in response to darkness.

---

24. Which hormone stimulates red blood cell production:

(A) Vasopressin

(B) Erythropoietin

(C) Erythrocytin

(D) Prolactin

Correct Answer: (B) Erythropoietin

Solution: Step 1: Understanding erythropoiesis. Erythropoiesis is the process of red blood cell (RBC) production, which occurs in the bone marrow. This process is stimulated by the hormone erythropoietin.

Step 2: Role of erythropoietin. Erythropoietin is secreted by the kidneys in response to low oxygen levels (hypoxia) in the blood. It acts on the bone marrow to increase the production of RBCs, thereby improving oxygen-carrying capacity.

Step 3: Why other options are incorrect. - (A) Vasopressin: Also known as antidiuretic hormone (ADH), it regulates water balance and blood pressure but does not stimulate RBC production. - (C) Erythrocytin: This is not a recognized hormone. - (D) Prolactin: Involved in lactation and other functions but unrelated to erythropoiesis.

Quick Tip

Erythropoietin is the key hormone for stimulating red blood cell production, secreted primarily by the kidneys in response to low oxygen levels.

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25. Which of the following drug does NOT require therapeutic drug monitoring:

(A) Digitoxin

(B) Phenytoin

(C) Gentamicin

(D) Acetaminophen

Correct Answer: (D) Acetaminophen

Solution: Step 1: Understanding therapeutic drug monitoring (TDM). Therapeutic drug monitoring is used for drugs with a narrow therapeutic index, where small changes in dosage can lead to toxicity or subtherapeutic effects.

Step 2: Analysis of given drugs. - (A) Digitoxin: Requires TDM because of its narrow therapeutic index and risk of toxicity, especially in cardiac patients. - (B) Phenytoin: Requires TDM due to its non-linear pharmacokinetics and risk of toxicity at high serum levels. - (C) Gentamicin: Requires TDM to avoid nephrotoxicity and ototoxicity, especially in patients with renal impairment. - (D) Acetaminophen: Does not require routine TDM as it has a wide therapeutic index and predictable pharmacokinetics, except in cases of suspected overdose.

Step 3: Conclusion. Acetaminophen is safe for most patients at therapeutic doses, making it the correct answer as the drug that does not require TDM.

Quick Tip

Therapeutic drug monitoring (TDM) is essential for drugs with a narrow therapeutic index, like Digitoxin, Phenytoin, and Gentamicin, but not for drugs like Acetaminophen with a wide therapeutic range.

Section D

1. The short-acting anticholinesterase drug is:

(A) Physostigmine

(B) Edrophonium

(C) Ecothiophate

(D) Neostigmine

Correct Answer: (B) Edrophonium

Solution: Step 1: Understanding anticholinesterase drugs. Anticholinesterase drugs inhibit the enzyme acetylcholinesterase, thereby increasing the levels of acetylcholine in the synaptic cleft. They are classified based on their duration of action into short-acting,

intermediate-acting, and long-acting drugs.

Step 2: Characteristics of Edrophonium. Edrophonium is a short-acting anticholinesterase drug with a rapid onset and brief duration of action (around 10-20 minutes). It is primarily used in the diagnosis of myasthenia gravis due to its quick effect.

Step 3: Why other options are incorrect. - (A) Physostigmine: Intermediate-acting anticholinesterase. - (C) Ecothiophate: Long-acting anticholinesterase, used in the treatment of glaucoma. - (D) Neostigmine: Intermediate-acting anticholinesterase, used in the treatment of myasthenia gravis and to reverse neuromuscular blockade.

Quick Tip

Edrophonium is the go-to drug for diagnosing myasthenia gravis due to its short duration of action and rapid onset.

---

2. Which among the following is an example of a high shear mixer:

(A) Turbine mixer

(B) Jet mixer

(C) Sigma blade mixer

(D) Nauta mixer

Correct Answer: (C) Sigma blade mixer

Solution: A high shear mixer is designed to generate intense mixing forces, which break down particles, droplets, or clumps in a mixture, enhancing the homogeneity of the system. The Sigma blade mixer is an example of a high shear mixer. It features two counter-rotating blades that move through the material at high speeds, creating a significant shear force that efficiently mixes the material.

- Turbine mixer: While it can create significant mixing action, it is generally used for mixing fluids or low-viscosity materials, but not specifically a high shear mixer. - Jet mixer: This type of mixer uses high-velocity jets of liquid to mix, but it is not considered a high shear mixer in the traditional sense. - Nauta mixer: This is a type of conical screw mixer used for mixing powders, but it does not generate the high shear forces typical of high shear mixers like the Sigma blade mixer.

Thus, the correct answer is C, as the Sigma blade mixer is a well-known high shear mixer used for intensive mixing operations.

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3. In a homologous series of any general anesthetic, increasing the chain length increases the lipid solubility and produces a corresponding increase in anesthetic potency, is proposed by:

(A) John Pemberton

(B) Meyer - Overton

(C) Hubert Humphrey

(D) Meyer - Philip

Correct Answer: (B) Meyer - Overton

Solution: Step 1: Understanding the Meyer-Overton correlation. The Meyer-Overton hypothesis states that the potency of general anesthetics is directly proportional to their lipid solubility. This means that as the lipid solubility of a compound increases (e.g., with increasing chain length in a homologous series), its anesthetic potency also increases.

Step 2: Importance of lipid solubility in anesthetic action. Lipid solubility is critical for anesthetic agents because they must cross the lipid-rich membranes of nerve cells to exert their effect. The Meyer-Overton hypothesis highlights this relationship.

Step 3: Why other options are incorrect. - (A) John Pemberton: Associated with Coca-Cola's invention, not anesthetics. - (C) Hubert Humphrey: A politician, unrelated to pharmacology or anesthetic theories. - (D) Meyer - Philip: Does not correspond to any theory in anesthetics.

Quick Tip

The Meyer-Overton hypothesis is fundamental in understanding how lipid solubility influences the potency of anesthetic agents.

---

4. Influenza viruses are RNA viruses and belong to which family:

(A) Orthomyxoviridae

(B) Papoviridae

(C) Retroviridae

(D) Parvoviridae

Correct Answer: (A) Orthomyxoviridae

Solution: Step 1: Understanding the influenza virus. Influenza viruses are RNA viruses that cause seasonal flu in humans and other animals. These viruses are characterized by their segmented, single-stranded RNA genome.

Step 2: Family classification of influenza viruses. Influenza viruses belong to the family Orthomyxoviridae. This family includes Influenza A, B, and C viruses, which are responsible for respiratory infections.

Step 3: Why other options are incorrect. - (B) Papoviridae: Includes double-stranded DNA viruses, such as papillomaviruses and polyomaviruses. - (C) Retroviridae: Includes RNA viruses like HIV that use reverse transcriptase for replication. - (D) Parvoviridae: Includes small DNA viruses, such as parvovirus B19.

Quick Tip

Influenza viruses are RNA viruses classified under the Orthomyxoviridae family, characterized by a segmented RNA genome and high mutation rates.

---

5. Two drugs producing the same clinical effects and safety profile when administered to patients are considered:

(A) Minimum Toxic Concentration (MTC)

(B) Minimum Effective Concentration (MEC)

(C) Therapeutic equivalent

(D) Therapeutic window

Correct Answer: (C) Therapeutic equivalent

Solution: Step 1: Understanding therapeutic equivalence. Therapeutic equivalence refers to two drugs that produce the same clinical effect and have a similar safety profile when administered in the same dosage form, strength, and route of administration. These drugs may differ in inactive ingredients but must demonstrate bioequivalence (similar rate and extent of absorption).

Step 2: Explanation of incorrect options. - (A) Minimum Toxic Concentration (MTC):

Refers to the lowest drug concentration at which toxic effects occur, unrelated to equivalence. - (B) Minimum Effective Concentration (MEC): Refers to the lowest concentration required to produce a therapeutic effect, unrelated to equivalence. - (D) Therapeutic window: Refers to the range between MEC and MTC, indicating drug safety, not equivalence.

Quick Tip

Therapeutic equivalence ensures two drugs have the same clinical effect and safety, often essential in substituting generic drugs for branded ones.

---

6. Aerobic dehydrogenase in biological oxidation contains:

(A) NAD

(B) NADH

(C) NADP

(D) FMN & FAD

Correct Answer: (D) FMN & FAD

Solution: Step 1: Role of aerobic dehydrogenases in biological oxidation. Aerobic dehydrogenases are enzymes that play a crucial role in biological oxidation by transferring electrons from substrates to the electron transport chain during aerobic respiration.

Step 2: Coenzymes associated with aerobic dehydrogenases. Aerobic dehydrogenases primarily use flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD) as their coenzymes. These flavins are involved in redox reactions, acting as electron carriers.

Step 3: Why other options are incorrect. - (A) NAD: Nicotinamide adenine dinucleotide is used by other dehydrogenases, such as those in glycolysis and the Krebs cycle, but not predominantly in aerobic dehydrogenases. - (B) NADH: Refers to the reduced form of NAD, a product of some metabolic pathways, not directly contained in aerobic dehydrogenases. - (C) NADP: Nicotinamide adenine dinucleotide phosphate is used in anabolic pathways, not in aerobic dehydrogenation.

Quick Tip

Aerobic dehydrogenases are flavoproteins containing FMN and FAD, crucial for transferring electrons in the electron transport chain.

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7. Match the following antibodies with their correct description:

Antibody	Description
P. IgE	(i) Cross the placenta
Q. IgG	(ii) Dominant antibody produced in immune responses
R. IgM	(iii) It is found in the mother's milk
S. IgA	(iv) Responsible for autoimmune responses including allergies

(A) P(i), Q(iii), R(ii), S(iv)

(B) P(i), Q(ii), R(iii), S(iv)

(C) P(iv), Q(ii), R(iii), S(i)

(D) P(iv), Q(i), R(ii), S(iii)

Correct Answer: (D) P(iv), Q(i), R(ii), S(iii)

Solution:

The following are the descriptions for each antibody:

- P. IgE: (iv) Responsible for autoimmune responses including allergies. IgE is involved in allergic reactions and immune responses to parasites. - Q. IgG: (i) Cross the placenta. IgG is the only antibody class that can cross the placenta, providing passive immunity to the fetus. - R. IgM: (ii) Dominant antibody produced in immune responses. IgM is the first antibody produced during an immune response and is crucial in the early immune defense. - S. IgA: (iii) It is found in the mother’s milk. IgA is the primary antibody found in mucosal surfaces such as breast milk, providing passive immunity to the newborn.

Thus, the correct matching is P(iv), Q(i), R(ii), S(iii).

Quick Tip

- IgE is involved in allergic reactions, IgG crosses the placenta to provide immunity to the fetus, IgM is the first response antibody, and IgA is found in mucosal areas like breast milk. - These antibodies are key to understanding immune responses and vaccine development.

---

8. Plasma protein bound drugs are:

(A) Pharmacodynamically active

(B) Pharmacokinetically inert

(C) Pharmacokinetically and Pharmacodynamically inert

(D) Pharmacodynamically inert

Correct Answer: (D) Pharmacodynamically inert

Solution: Step 1: Understanding plasma protein binding. Many drugs bind to plasma proteins, primarily albumin. Only the free (unbound) drug is available for pharmacological action. The protein-bound fraction serves as a reservoir, gradually releasing the drug as the free form is metabolized or excreted.

Step 2: Pharmacodynamic and pharmacokinetic implications. - Pharmacodynamically inert: Since bound drugs cannot interact with receptors or target tissues, they are pharmacodynamically inactive. - Pharmacokinetically active: Plasma-bound drugs can influence drug distribution and half-life but are not inert in pharmacokinetic terms.

Step 3: Why other options are incorrect. - (A) Pharmacodynamically active: Incorrect, as only free drugs interact with receptors. - (B) Pharmacokinetically inert: Incorrect, as binding affects drug distribution and elimination. - (C) Pharmacokinetically and pharmacodynamically inert: Incorrect, because plasma-bound drugs influence pharmacokinetics but not pharmacodynamics.

Quick Tip

Only the free drug fraction is pharmacodynamically active. Plasma protein binding extends drug half-life but delays immediate pharmacological effects.

9. Which of the following equipment measures weight variation using reflected energy:

(A) Rotofill

(B) Vericap-1200

(C) Rotosort

(D) Rotoweight

Correct Answer: (D) Rotoweight

Solution: Step 1: Understanding weight measurement using reflected energy.

Rotoweight is an advanced equipment used in pharmaceutical and industrial applications for measuring weight variation. It utilizes reflected energy technology to determine the weight of objects without direct contact, ensuring high accuracy and efficiency in weight monitoring.

Step 2: Explanation of other options. - (A) Rotofill: Used for precise filling of powders or liquids into containers. - (B) Vericap-1200: A capsule-filling machine, not related to weight measurement. - (C) Rotosort: Used for sorting objects based on predefined parameters, not for weight measurement.

Step 3: Why Rotoweight is the correct choice. Rotoweight's use of reflected energy technology makes it ideal for weight variation analysis, ensuring accuracy without physical interference with the sample.

Quick Tip

Rotoweight is a specialized equipment that measures weight variations using reflected energy, ensuring precision in pharmaceutical and industrial applications.

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10. Which among the following is not the process of drug degradation:

(A) Photolysis

(B) Decarboxylation

(C) Hemolysis

(D) Hydrolysis

Correct Answer: (C) Hemolysis

Solution: Step 1: Understanding drug degradation processes. Drug degradation refers to

the chemical breakdown of pharmaceutical compounds, leading to loss of potency and stability. The major processes of drug degradation include: - Photolysis: Breakdown of a drug due to exposure to light. - Decarboxylation: Loss of a carboxyl group ($-COOH$), leading to structural modifications. - Hydrolysis: Reaction with water causing drug decomposition, common in esters and amides.

Step 2: Why hemolysis is incorrect. - Hemolysis refers to the breakdown of red blood cells (RBCs), releasing hemoglobin into the blood. It is a biological process, not related to drug degradation.

Step 3: Explanation of incorrect options. - (A) Photolysis, (B) Decarboxylation, and (D) Hydrolysis are all valid mechanisms of drug degradation.

Quick Tip

Drug degradation occurs via processes like hydrolysis, oxidation, photolysis, and decarboxylation. Hemolysis is unrelated as it involves the destruction of red blood cells.

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11. The term of a patent granted under the Indian Patent Act is:

(A) 20 Years

(B) 10 Years

(C) 30 Years

(D) 40 Years

Correct Answer: (A) 20 Years

Solution: Step 1: Understanding the Indian Patent Act. Under the Indian Patent Act, a patent is granted for a fixed period to provide exclusive rights to the inventor to manufacture, use, sell, and distribute the invention.

Step 2: Duration of Patent Protection. According to The Patents Act, 1970 (as amended in 2005), the term of a patent in India is 20 years from the date of filing, provided renewal fees are paid regularly. This applies to all types of patents, including pharmaceuticals, industrial, and software-related inventions.

Step 3: Why other options are incorrect. - (B) 10 Years: Incorrect, as patents are not granted for a 10-year term under the Indian system. - (C) 30 Years and (D) 40 Years:

Incorrect, as Indian patent laws do not extend beyond 20 years.

Quick Tip

The term of a patent in India is 20 years from the date of filing, as per The Patents Act, 1970 (amended in 2005). Ensure renewal fees are paid to maintain the patent.

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12. Choose the incorrect statement regarding Cathode rays:

(A) Cathode rays produce X-rays

(B) Cathode rays are electromagnetic waves

(C) Cathode rays travel in a straight route

(D) Cathode rays are fast electrons

Correct Answer: (B) Cathode rays are electromagnetic waves

Solution: Step 1: Understanding cathode rays. Cathode rays are streams of high-speed electrons emitted from the cathode in a vacuum tube. They possess mass and negative charge and exhibit particle-like properties.

Step 2: Evaluating given statements. - (A) Cathode rays produce X-rays: Correct. When cathode rays strike a metal target, X-rays are generated due to energy conversion. - (B) Cathode rays are electromagnetic waves: Incorrect. Cathode rays are not electromagnetic waves; they are charged particles (electrons). Electromagnetic waves (like X-rays) have no charge or mass. - (C) Cathode rays travel in a straight route: Correct. In the absence of external magnetic or electric fields, cathode rays move in straight lines. - (D) Cathode rays are fast electrons: Correct. They consist of negatively charged high-speed electrons moving from the cathode to the anode.

Step 3: Conclusion. Since cathode rays are not electromagnetic waves, option (B) is incorrect, making it the correct answer for this question.

Quick Tip

Cathode rays are streams of fast-moving electrons, not electromagnetic waves. They travel in straight lines unless influenced by electric or magnetic fields.

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13. Among the following, which is known as ”SPIRIT OF SALT”?

(A) Nitric acid

(B) Boric acid

(C) Hydrochloric acid

(D) Thioglycolic acid

Correct Answer: (C) Hydrochloric acid

Solution:

”Spirit of Salt” is a common name for Hydrochloric acid (HCl). It is a strong acid commonly used in laboratories and industries. The term ”Spirit of Salt” likely originates from the historical association with the preparation of the acid, which involved the use of salt (sodium chloride) and sulfuric acid.

Why Other Options Are Incorrect: - (A) Nitric acid: Nitric acid (HNO_3) is a strong acid but is not known as ”Spirit of Salt”. - (B) Boric acid: Boric acid (H_3BO_3) is a weak acid and is not referred to as ”Spirit of Salt”. - (D) Thioglycolic acid: Thioglycolic acid ($HSCH_2COOH$) is a different organic acid used in cosmetics and hair treatment, not known as ”Spirit of Salt”.

Thus, Hydrochloric acid is the correct answer as it is commonly referred to as ”Spirit of Salt”.

Quick Tip

- Hydrochloric acid is often called ”Spirit of Salt” due to its historical preparation process. - It is widely used in industrial applications, cleaning, and chemical synthesis.

---

14. Partial hydrogenation of vegetable oils in the presence of Ni catalyst at 200°C gives:

(A) Butter

(B) Vanaspati ghee

(C) Cheese

(D) Margarine

Correct Answer: (D) Margarine

Solution: Partial hydrogenation of vegetable oils involves adding hydrogen to unsaturated

fats in the presence of a nickel catalyst at high temperatures. This process converts some of the double bonds in the unsaturated fats into single bonds, making the fats more solid and stable. Butter is a dairy product made from cream or milk and is not produced by hydrogenation. Vanaspati ghee is typically made by fully hydrogenating vegetable oils, not partial hydrogenation. Cheese is a dairy product unrelated to hydrogenation. Margarine, on the other hand, is produced by partial hydrogenation of vegetable oils, making it the correct answer.

Conclusion: The correct answer is (D) Margarine.

Quick Tip

Partial hydrogenation converts liquid vegetable oils into semi-solid fats like margarine.

Nickel is a common catalyst used in hydrogenation reactions.

Fully hydrogenated oils are used to make products like vanaspati ghee.

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15. As per Bronsted-Lowry concept, acid is defined as:

(A) Electron pair acceptor

(B) Any substance/molecule that can accept a proton

(C) Any substance/molecule that can donate a proton

(D) Electron pair donor

Correct Answer: (C) Any substance/molecule that can donate a proton

Solution: Step 1: Understanding the Bronsted-Lowry concept. The Bronsted-Lowry theory defines acids and bases based on proton (H^+) transfer: - Acid: A substance that donates a proton (H^+) in a reaction. - Base: A substance that accepts a proton (H^+).

Step 2: Explanation of correct answer. According to the Bronsted-Lowry concept, an acid is any molecule or ion that donates a proton (H^+), which makes option (C) correct.

Step 3: Why other options are incorrect. - (A) Electron pair acceptor: This definition aligns with Lewis acids, not Bronsted-Lowry acids. - (B) Any substance/molecule that can accept a proton: This defines a Bronsted-Lowry base, not an acid. - (D) Electron pair donor: This describes Lewis bases, not acids.

Quick Tip

In the Bronsted-Lowry theory, acids donate protons (H^+), while bases accept protons. This theory explains acid-base reactions in aqueous and non-aqueous systems.

---

16. Which of the following is a correct expression of average particle size with the value of $p = 1$ (size index) and frequency index $f = 2$:

A	B	C	D
$d_{ln} = \frac{\sum nd^2}{\sum nd^3}$	$d_{ln} = \frac{\sum nd^3}{\sum nd^2}$	$d_{sl} = \frac{\sum nd^2}{\sum nd^3}$	$d_{sl} = \frac{\sum nd^3}{\sum nd^2}$

(A) B

(B) C

(C) D

(D) A

Correct Answer: (B) C

Step 1: Understanding the given problem

The problem asks for the correct expression of average particle size with an index value of $p = 1$. The index p is related to the size of an individual particle, and the frequency index is given as $f = 2$. This suggests that we need to use the appropriate formula for particle size distribution.

Step 2: Identifying the correct formula

The general formula for the size index is:

$$d_{pq} = \frac{\sum nd^{p+q}}{\sum nd^{p+q-1}}$$

For $p = 1$ and $q = n$, we substitute these values:

$$d_{s1} = \frac{\sum nd^2}{\sum nd^3}$$

This matches option (B), making it the correct answer.

Quick Tip

To find the average particle size, use the formula:

$$d_{1f} = \frac{\sum nd^{f+1}}{\sum nd^{f}}$$

where p is the size index and f is the frequency index.

---

17. Which of the following is a peroxisome proliferator-activated receptor-alpha (PPAR-α) agonist:

(A) Ezetimibe

(B) Niacin

(C) Colesevelam

(D) Gemfibrozil

Correct Answer: (D) Gemfibrozil

Solution: Step 1: Understanding PPAR-α agonists. Peroxisome proliferator-activated receptor-alpha (PPAR-α) is a nuclear receptor that regulates lipid metabolism. PPAR-α agonists, also known as fibrates, are used to lower triglyceride levels and increase HDL cholesterol in patients with dyslipidemia.

Step 2: Role of Gemfibrozil as a PPAR-α agonist. Gemfibrozil is a fibrate class drug that activates PPAR-α, leading to: - Increased fatty acid oxidation. - Decreased triglyceride levels. - Increased HDL cholesterol levels.

Step 3: Why other options are incorrect. - (A) Ezetimibe: Inhibits intestinal cholesterol absorption by blocking NPC1L1, not a PPAR-α agonist. - (B) Niacin: Reduces triglycerides and LDL by inhibiting lipolysis but does not act on PPAR-α. - (C) Colesevelam: A bile acid sequestrant that lowers LDL cholesterol, unrelated to PPAR-α activation.

Quick Tip

Fibrates like Gemfibrozil and Fenofibrate are PPAR-α agonists used to lower triglycerides and increase HDL levels in dyslipidemia patients.

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18. The given equation represents which law:

$$E = K_k \ln \frac{d_1}{d_2}$$

(A) Rittinger's law

(B) Bond's law

(C) Fick's law

(D) Kick's law

Correct Answer: (D) Kick's law

Solution: Step 1: Understanding the given equation. The given equation:

$$E = K_k \ln \frac{d_1}{d_2}$$

relates energy (E) to the size reduction of particles (d_1 and d_2). This equation is derived from Kick's law, which states that the energy required for size reduction is proportional to the logarithm of the ratio of initial to final particle sizes.

Step 2: Explanation of Kick's Law. Kick's law is expressed as:

$$E = K_k \ln \frac{d_1}{d_2}$$

where: - E = Energy required for size reduction, - K_k = Kick's constant, - d_1 and d_2 = Initial and final particle sizes.

Step 3: Why other options are incorrect. - (A) Rittinger's law: States that energy required is proportional to the new surface area created, using $E = K_R \left(\frac{1}{d_2} - \frac{1}{d_1}\right)$. - (B) Bond's law: Uses an empirical equation to calculate energy consumption in size reduction. - (C) Fick's law: Describes diffusion, unrelated to particle size reduction.

Quick Tip

Kick's law is used for coarse grinding, assuming that energy required is proportional to the logarithm of size reduction ratio.

---

19. In which limit test is Thioglycolic acid used:

(A) Limit test for arsenic

(B) Limit test for sulphate

(C) Limit test for iron

(D) Limit test for chloride

Correct Answer: (C) Limit test for iron

Solution: Step 1: Understanding the use of Thioglycolic acid in limit tests. Thioglycolic acid is a chelating agent used in analytical chemistry. In the limit test for iron, it acts as a reducing agent, converting ferric ions (Fe^{3+}) into ferrous ions (Fe^{2+}).

Step 2: Role in the limit test for iron. - In this test, Thioglycolic acid reacts with Fe^{3+}, reducing it to Fe^{2+}, which then forms a pink to purple-colored complex with o-phenanthroline in an acidic medium. - The intensity of this color is compared against a standard solution to determine the permissible limit of iron impurities.

Step 3: Why other options are incorrect. - (A) Limit test for arsenic: Uses Gutzeit or Marsh's test, involving hydrogen sulfide or silver diethyldithiocarbamate. - (B) Limit test for sulphate: Uses barium chloride, not thioglycolic acid. - (D) Limit test for chloride: Uses silver nitrate, forming a white precipitate of silver chloride (AgCl).

Quick Tip

Thioglycolic acid is specifically used in the limit test for iron, where it reduces Fe^{3+} to Fe^{2+}, forming a colored complex for detection.

---

20. Who has the power to fix the ceiling price of scheduled formulations:

(A) Director General Health Services

(B) Pharmacy Council of India

(C) National Medical Commission

(D) National Pharmaceutical Pricing Authority

Correct Answer: (D) National Pharmaceutical Pricing Authority

Solution: Step 1: Understanding the regulation of drug pricing in India. In India, the National Pharmaceutical Pricing Authority (NPPA) is responsible for controlling and regulating the prices of essential medicines, also known as scheduled formulations under the Drug Price Control Order (DPCO).

Step 2: Role of NPPA. - The NPPA sets the ceiling price for drugs listed in the National List of Essential Medicines (NLEM) to ensure their affordability. - It monitors drug prices and

takes action against overpricing to protect consumer interests.

Step 3: Why other options are incorrect. - (A) Director General Health Services: Focuses on public health programs and hospital administration, not drug pricing. - (B) Pharmacy Council of India: Regulates pharmacy education and profession, not pharmaceutical pricing. - (C) National Medical Commission: Regulates medical education and practices but does not control drug prices.

Quick Tip

The National Pharmaceutical Pricing Authority (NPPA) is responsible for fixing the ceiling price of essential medicines to ensure affordability and prevent overpricing.

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21. Which of the following is not a GABA derivative:

(A) Pregabalin

(B) Vigabatrin

(C) Gabapentin

(D) Rufinamide

Correct Answer: (D) Rufinamide

Solution: Step 1: Understanding GABA derivatives. Gamma-Aminobutyric Acid (GABA) derivatives are drugs structurally related to GABA and function as central nervous system (CNS) depressants, primarily used as anticonvulsants or neuropathic pain medications.

Step 2: Classification of the given drugs. - (A) Pregabalin: A GABA analog used for neuropathic pain, epilepsy, and generalized anxiety disorder. - (B) Vigabatrin: A GABA derivative that inhibits GABA transaminase, increasing GABA levels. - (C) Gabapentin: A GABA analog that modulates calcium channels, used for seizures and neuropathic pain. - (D) Rufinamide: Not a GABA derivative. It is an anticonvulsant that works by prolonging sodium channel inactivation.

Step 3: Why Rufinamide is the correct answer. Unlike Pregabalin, Gabapentin, and Vigabatrin, which are structurally related to GABA, Rufinamide is a triazole derivative and does not mimic GABA activity. Instead, it stabilizes sodium channels to prevent seizures.

Quick Tip

GABA derivatives include Pregabalin, Gabapentin, and Vigabatrin, whereas Rufinamide is a sodium channel modulator and not structurally related to GABA.

---

22. A hypothesis stipulating that there is no difference between the situations, groups, and outcomes is called:

(A) Hypothesis of association

(B) Null hypothesis

(C) Hypothesis of differences

(D) Alternative hypothesis

Correct Answer: (B) Null hypothesis

Solution: Step 1: Understanding the Null Hypothesis. A Null Hypothesis (H_0) is a statement that there is no significant difference between two situations, groups, or outcomes. It assumes that any observed difference is due to chance or random variation.

Step 2: Importance in hypothesis testing. - The null hypothesis is tested against an alternative hypothesis (H_1), which proposes that there is a significant effect or difference. - Statistical tests are used to determine whether to reject or fail to reject the null hypothesis.

Step 3: Explanation of incorrect options. - (A) Hypothesis of association: Refers to relationships between variables, not the absence of difference. - (C) Hypothesis of differences: Describes a hypothesis that assumes a difference exists, but it is not the same as the null hypothesis. - (D) Alternative hypothesis: Opposes the null hypothesis by suggesting that a difference does exist.

Quick Tip

The Null Hypothesis (H_0) assumes no difference between groups or conditions. It is the starting point for statistical hypothesis testing.

---

23. How many Pharmacists are required for a hospital having up to 300 beds:

(A) 8

(B) 10

(C) 15

(D) 5

Correct Answer: (B) 10

Solution: Step 1: Understanding pharmacist requirements in hospitals. According to the Medical Council of India (MCI) and Pharmacy Council of India (PCI) guidelines, hospitals must have an adequate number of pharmacists based on the number of hospital beds.

Step 2: Pharmacist requirement for hospitals up to 300 beds. - For hospitals with up to 300 beds, a minimum of 10 pharmacists is required. - For larger hospitals (above 300 beds), additional pharmacists are needed based on workload.

Step 3: Why other options are incorrect. - (A) 8: Less than the recommended requirement for a 300-bed hospital. - (C) 15: Exceeds the minimum requirement, though may be needed for larger hospitals. - (D) 5: Insufficient for handling the pharmaceutical needs of 300 patients.

Quick Tip

For hospitals up to 300 beds, at least 10 pharmacists are required as per PCI and MCI guidelines.

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24. Which of the following is easily nitrated using a mixture of HNO_3 and H_2SO_4:

(A) Toluene

(B) Fluorobenzene

(C) Chlorobenzene

(D) Nitrobenzene

Correct Answer: (A) Toluene

Solution: Step 1: Understanding the nitration reaction. Nitration is an electrophilic aromatic substitution reaction where a benzene derivative reacts with a mixture of concentrated nitric acid (HNO_3) and sulfuric acid (H_2SO_4) to introduce a nitro group (-NO_2) onto the aromatic ring.

Step 2: Reactivity of the given compounds. - Toluene ($C_6H_5CH_3$) has a +I

(electron-donating) methyl group, which increases the electron density on the benzene ring, making it highly reactive towards nitration. - Fluorobenzene (C_6H_5F) has a fluorine atom, which has both electron-donating and electron-withdrawing effects, but its overall influence is deactivating. - Chlorobenzene (C_6H_5Cl) is less reactive than benzene due to chlorine's -I effect (electron withdrawal). - Nitrobenzene ($C_6H_5NO_2$) has a strong -I and -M effect (electron-withdrawing), making it very deactivated toward further nitration.

Step 3: Conclusion. Since toluene is the most activated due to the electron-donating methyl group, it undergoes nitration most easily.

Quick Tip

Toluene undergoes nitration faster than benzene due to its electron-donating methyl group (+I effect), increasing its reactivity in electrophilic aromatic substitution reactions.

---

25. If the spin of the electrons in the excited state are parallel, it is called as:

(A) Doublet state

(B) Triplet state

(C) Singlet state

(D) Parallel state

Correct Answer: (B) Triplet state

Solution: Step 1: Understanding electronic spin states. When an electron in a molecule or atom gets excited, it moves to a higher energy level. The total spin of the system determines whether the state is singlet, triplet, or other multiplicities.

Step 2: Characteristics of a triplet state. - In a singlet state, the electron spins are paired (opposite), meaning the total spin quantum number $S = 0$. - In a triplet state, the electron spins are parallel, meaning the total spin quantum number $S = 1$. - The triplet state is lower in energy than the singlet excited state because parallel spins reduce electron repulsion.

Step 3: Why other options are incorrect. - (A) Doublet state: Applies to systems with an unpaired electron, such as free radicals. - (C) Singlet state: Electrons have paired spins ($S = 0$), not parallel. - (D) Parallel state: Not a standard term in quantum chemistry.

Quick Tip

If the excited-state electron spins are parallel, the system is in a triplet state. If they are paired (opposite), the system is in a singlet state.

Section E

1. The amount of air that moves in or out of the lungs with each respiratory cycle is:

(A) Inspiratory reserve volume

(B) Expiratory reserve volume

(C) Tidal volume

(D) Residual volume

Correct Answer: (C) Tidal volume

Solution: Step 1: Understanding lung volumes. Lung volumes are physiological measurements that describe different aspects of respiration: - Tidal volume (TV): The amount of air that moves in and out of the lungs with each normal breath (500 mL in an average adult). - Inspiratory reserve volume (IRV): The additional air that can be inhaled after a normal inspiration. - Expiratory reserve volume (ERV): The additional air that can be exhaled after a normal expiration. - Residual volume (RV): The air remaining in the lungs after maximum expiration.

Step 2: Why tidal volume is the correct answer. Since the question asks for the air exchanged during each normal respiratory cycle, this directly corresponds to the tidal volume (TV), which represents the regular breathing volume.

Step 3: Why other options are incorrect. - (A) Inspiratory reserve volume: Represents extra air inhaled beyond normal breathing, not the standard breath volume. - (B) Expiratory reserve volume: Represents extra air exhaled beyond normal breathing, not the standard breath volume. - (D) Residual volume: Represents air remaining in the lungs after full expiration, not the air exchanged in a normal breath.

Quick Tip

Tidal volume (TV) is the air exchanged during each normal breath, approximately 500 mL in an average adult.

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2. Virus-mediated transfer of host DNA from one cell to another cell is known as:

(A) Transduction

(B) Integration

(C) Transformation

(D) Transcription

Correct Answer: (A) Transduction

Solution: Step 1: Understanding transduction. Transduction is a process in which a bacteriophage (virus) transfers genetic material from one bacterial cell to another. This occurs when a phage accidentally packages host DNA instead of viral DNA and injects it into another bacterium.

Step 2: Types of transduction. - Generalized transduction: Any bacterial gene can be transferred. - Specialized transduction: Only specific bacterial genes near the phage integration site are transferred.

Step 3: Why other options are incorrect. - (B) Integration: Refers to viral DNA integrating into the host genome, not transferring host DNA. - (C) Transformation: Involves uptake of free DNA from the environment by bacteria, not virus-mediated. - (D) Transcription: The process of RNA synthesis from DNA, unrelated to gene transfer.

Quick Tip

Transduction is the virus-mediated transfer of genetic material between bacterial cells, often involving bacteriophages.

---

3. What should be the log P value for an ideal drug candidate for transdermal permeation:

(A) Below 1

(B) 1-3

(C) 5-7

(D) Above 7

Correct Answer: (B) 1-3

Solution: Step 1: Understanding log P value. The log P value is a measure of a drug's lipophilicity, representing its distribution between a lipid (oil) phase and an aqueous phase. It determines how easily a drug can permeate lipid membranes, such as the skin.

Step 2: Log P value range for transdermal permeation. For transdermal delivery, the drug must have balanced hydrophilic and lipophilic properties: - A log P value of 1-3 is ideal, ensuring sufficient lipid solubility for permeating the skin's lipid barrier while maintaining water solubility for systemic absorption.

Step 3: Why other options are incorrect. - (A) Below 1: Too hydrophilic, making it difficult to cross the lipid-rich stratum corneum. - (C) 5-7: Too lipophilic, leading to accumulation in the skin and poor systemic absorption. - (D) Above 7: Extremely lipophilic, making it almost impossible to achieve systemic delivery.

Quick Tip

For transdermal drugs, a log P value of 1-3 ensures optimal permeation through the lipid-rich skin barrier while maintaining systemic bioavailability.

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4. Which of the following formula for calculating child dose is based on body weight:

(A) Clark's formula

(B) Fried's formula

(C) Young's formula

(D) Dilling's formula

Correct Answer: (A) Clark's formula

Solution: Step 1: Understanding Clark's formula. Clark's formula calculates the child's dose of a medication based on the child's body weight, ensuring accurate dosing to avoid toxicity or underdosing. The formula is:

$$\text{Child's Dose} = \frac{\text{Weight of the child (kg)}}{70} \times \text{Adult Dose}$$

or, in pounds:

$$\text{Child's Dose} = \frac{\text{Weight of the child (lb)}}{150} \times \text{Adult Dose}.$$

Step 2: Explanation of other formulas. - (B) Fried's formula: Based on the child's age in months. - (C) Young's formula: Based on the child's age in years. - (D) Dilling's formula: Also based on the child's age in years, specifically for older children.

Step 3: Conclusion. Since Clark's formula considers the child's body weight for dose calculation, option (A) is correct.

Quick Tip

Use Clark's formula for dose calculations based on body weight to ensure accurate and safe dosing for children.

---

5. Salivary amylase helps in digestion of which of the following nutrients:

(A) Fats

(B) Vitamins

(C) Starch

(D) Proteins

Correct Answer: (C) Starch

Solution: Step 1: Function of salivary amylase. Salivary amylase is an enzyme secreted by the salivary glands that initiates the breakdown of starch (a carbohydrate) into maltose and dextrins in the mouth during digestion.

Step 2: Why starch is the correct answer. Salivary amylase specifically acts on polysaccharides like starch, hydrolyzing the glycosidic bonds. It does not act on fats, vitamins, or proteins.

Step 3: Why other options are incorrect. - (A) Fats: Digestion of fats is initiated by lipase, not amylase. - (B) Vitamins: Vitamins do not require enzymatic digestion. - (D) Proteins: Digestion of proteins begins in the stomach with pepsin, not salivary amylase.

Quick Tip

Salivary amylase starts the digestion of starch in the mouth, converting it into maltose and dextrins.

---

6. In the drying process, which of the following parameters is the same as the adiabatic saturation temperature:

(A) Absolute humidity

(B) Dew point

(C) Relative humidity

(D) Wet bulb temperature

Correct Answer: (D) Wet bulb temperature

Solution: Step 1: Understanding adiabatic saturation temperature. The adiabatic saturation temperature is the temperature at which air becomes saturated with water vapor through the evaporation process under adiabatic conditions (without heat exchange with the surroundings).

Step 2: Relation to wet bulb temperature. The wet bulb temperature is the temperature measured by a thermometer covered with a wet cloth, where the evaporation of water cools the thermometer. Under adiabatic conditions, the wet bulb temperature equals the adiabatic saturation temperature.

Step 3: Why other options are incorrect. - (A) Absolute humidity: Refers to the mass of water vapor in a given volume of air, unrelated to temperature. - (B) Dew point: The temperature at which air becomes saturated and condensation begins, different from the wet bulb temperature. - (C) Relative humidity: The ratio of the actual water vapor content to the maximum possible water vapor content at a specific temperature, not the same as the adiabatic saturation temperature.

Quick Tip

The wet bulb temperature represents the adiabatic saturation temperature, as both involve cooling due to evaporation without external heat exchange.

---

7. What is the proposed mechanism of action of artemisinin in the treatment of malaria:

(A) Inhibition of dihydrofolate reductase, interfering with folate synthesis

(B) Blocking of the Plasmodium falciparum ATPase, disrupting ion homeostasis

(C) Generation of reactive oxygen species (ROS) by cleavage of the endoperoxide bridge, leading to parasite death

(D) Inhibition of the heme polymerase enzyme, causing accumulation of toxic heme

Correct Answer: (C) Generation of reactive oxygen species (ROS) by cleavage of the endoperoxide bridge, leading to parasite death

Solution: Step 1: Understanding artemisinin's mechanism. Artemisinin is an antimalarial drug derived from the plant Artemisia annua. Its activity is based on the cleavage of its endoperoxide bridge by iron (from heme) within the malaria parasite. This cleavage generates reactive oxygen species (ROS), which damage the parasite's essential proteins and membranes, leading to its death.

Step 2: Why other options are incorrect. - (A) Inhibition of dihydrofolate reductase: This is the mechanism of action of drugs like pyrimethamine, not artemisinin. - (B) Blocking of Plasmodium falciparum ATPase: This mechanism is related to other drugs like lumefantrine, not artemisinin. - (D) Inhibition of heme polymerase enzyme: This is the mechanism of quinoline-based drugs like chloroquine, not artemisinin.

Step 3: Conclusion. The correct mechanism of artemisinin involves ROS generation through endoperoxide cleavage, making option (C) the correct answer.

Quick Tip

Artemisinin works by generating reactive oxygen species (ROS) through cleavage of its endoperoxide bridge, causing oxidative damage to the malaria parasite.

---

8. The optimum temperature for rapid growth of mesophiles is:

(A) $40^{\circ}C$ to $50^{\circ}C$

(B) $50^{\circ}C$ to $60^{\circ}C$

(C) $15^{\circ}C$ to $20^{\circ}C$

(D) $25^{\circ}C$ to $40^{\circ}C$

Correct Answer: (D) 25 to $40°C$

Solution: Step 1: Understanding mesophiles. Mesophiles are microorganisms that thrive in moderate temperature ranges. They are commonly found in environments such as soil, water, and the human body.

Step 2: Optimum temperature range. Mesophiles grow best at temperatures between $20°C$ and $45°C$, with the most rapid growth occurring between $25°C$ and $40°C$. This range supports their metabolic and enzymatic activities.

Conclusion: The correct answer is (D) $25°C$ to $40°C$.

Quick Tip

Microorganisms are classified by their optimum growth temperatures: - Psychrophiles: $-5°C$ to $15°C$. - Mesophiles: $20°C$ to $45°C$. - Thermophiles: $45°C$ to $80°C$. Understanding these classifications helps in microbiology and industrial processes.

---

9. The fluoroquinolones act by:

(A) Inhibiting folic acid synthesis, reducing nucleotide production and DNA synthesis

(B) Inhibiting DNA gyrase and topoisomerase IV, causing supercoiling and fragmentation of bacterial DNA

(C) Disrupting peptidoglycan cross-linking, weakening the bacterial cell wall

(D) Inhibiting ribosomal subunits, leading to the cessation of protein synthesis

Correct Answer: (B) Inhibiting DNA gyrase and topoisomerase IV, causing supercoiling and fragmentation of bacterial DNA

Solution: Step 1: Mechanism of fluoroquinolones. Fluoroquinolones are a class of broad-spectrum antibiotics that target bacterial enzymes involved in DNA replication. Specifically, they inhibit DNA gyrase and topoisomerase IV, which are essential for relieving supercoiling tension during DNA replication and transcription.

Step 2: Effects of inhibition. By inhibiting these enzymes, fluoroquinolones prevent bacterial DNA from properly unwinding and replicating. This results in supercoiling, DNA fragmentation, and ultimately bacterial cell death.

Step 3: Comparison with other options. - Option (A): Describes the mechanism of

sulfonamides and trimethoprim. - Option (C): Refers to the action of beta-lactam antibiotics (e.g., penicillins). - Option (D): Refers to antibiotics like tetracyclines and aminoglycosides.
Conclusion: The correct answer is (B).

Quick Tip

Fluoroquinolones, such as ciprofloxacin and levofloxacin, are commonly used to treat bacterial infections. Their unique target, DNA gyrase, makes them effective against both Gram-positive and Gram-negative bacteria.

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10. The cranial nerve that regulates the heartbeat is:

(A) IX

(B) VII

(C) X

(D) VIII

Correct Answer: (C) X

Solution: Step 1: Identification of the cranial nerve. The cranial nerve responsible for regulating the heartbeat is the vagus nerve, also known as cranial nerve X.
Step 2: Function of the vagus nerve. The vagus nerve is a mixed nerve that plays a significant role in parasympathetic control over the heart. It helps decrease the heart rate by releasing acetylcholine, which slows down the electrical impulses in the sinoatrial (SA) node of the heart.
Step 3: Comparison with other options. - Option (A): Cranial nerve IX (glossopharyngeal nerve) is involved in taste and the gag reflex, not heartbeat regulation. - Option (B): Cranial nerve VII (facial nerve) controls facial expressions and salivary glands. - Option (D): Cranial nerve VIII (vestibulocochlear nerve) is responsible for balance and hearing.
Conclusion: The correct answer is (C) X (vagus nerve).

Quick Tip

The vagus nerve not only regulates the heartbeat but also controls other parasympathetic activities, such as digestion and respiratory rate. Damage to this nerve can lead to cardiovascular or digestive issues.

---

11. Which of the following is a causative organism for Syphilis:

(A) Vibrio cholerae

(B) Treponema pallidum

(C) Bacillus pertussis

(D) Clostridium tetani

Correct Answer: (B) Treponema pallidum

Solution: Step 1: Understanding Syphilis. Syphilis is a sexually transmitted infection (STI) caused by the bacterium Treponema pallidum. It is a spirochete bacterium that primarily spreads through sexual contact or from mother to fetus during pregnancy (congenital syphilis).

Step 2: Comparison with other organisms. - Option (A): Vibrio cholerae causes cholera, an acute diarrheal disease. - Option (C): Bacillus pertussis causes whooping cough (pertussis). - Option (D): Clostridium tetani causes tetanus, characterized by severe muscle spasms.

Step 3: Conclusion. Only Treponema pallidum is the causative organism for syphilis.

Conclusion: The correct answer is (B) Treponema pallidum.

Quick Tip

Syphilis progresses through several stages: primary, secondary, latent, and tertiary. Early diagnosis and treatment with antibiotics like penicillin are critical to preventing severe complications.

---

12. Coomb's test is used for detection of:

(A) Yellow fever

(B) Syphilis

(C) Typhoid

(D) Antiglobulin

Correct Answer: (D) Antiglobulin

Solution: Step 1: Understanding the Coomb's test. The Coomb's test, also known as the antiglobulin test, is used to detect antibodies or complement proteins that are bound to the surface of red blood cells. It is primarily used in immunohematology.

Step 2: Types of Coomb's test. - Direct Coomb's Test (DCT): Detects antibodies bound to red blood cells in conditions like hemolytic anemia or hemolytic disease of the newborn. - Indirect Coomb's Test (ICT): Detects antibodies in the serum, such as those present in transfusion reactions or during pregnancy.

Step 3: Comparison with other options. - Option (A): Yellow fever is detected by serological tests or PCR, not Coomb's test. - Option (B): Syphilis is detected using tests like VDRL or TPHA. - Option (C): Typhoid is diagnosed using the Widal test or blood culture.

Conclusion: The Coomb's test is specifically used for the detection of antiglobulin, making (D) the correct answer.

Quick Tip

The Coomb's test is essential in blood transfusion compatibility testing and diagnosing autoimmune conditions like hemolytic anemia.

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13. In Michaelis-Menten equation when $K_m = C$:

(A) The rate of process is equal to half of maximum rate

(B) Indicates zero-order process

(C) The rate process occurs at a constant rate

(D) Equation becomes identical to first-order elimination of drug

Correct Answer: (A) The rate of process is equal to half of maximum rate

Solution: Step 1: Michaelis-Menten equation. The Michaelis-Menten equation is given by:

$$v = \frac{V_{\text{max}} \cdot [S]}{K_m + [S]}$$

where: - v is the reaction rate, - V_{max} is the maximum rate, - $[S]$ is the substrate concentration, - K_m is the Michaelis constant (substrate concentration at which the reaction rate is half of V_{max}).

Step 2: Condition when $K_m = C$. When $[S] = K_m$:

$$v = \frac{V_{\text{max}} \cdot K_m}{K_m + K_m} = \frac{V_{\text{max}}}{2}$$

This shows that the rate of the process is equal to half of the maximum rate (V_{max}) when the substrate concentration equals the Michaelis constant (K_m).

Step 3: Comparison with other options. - Option (B): Zero-order kinetics occur when $[S] \gg K_m$. - Option (C): Constant rate occurs in zero-order kinetics. - Option (D): First-order elimination occurs when $[S] \ll K_m$.

Conclusion: The correct answer is (A).

Quick Tip

Michaelis-Menten kinetics describe the relationship between substrate concentration and reaction rate. Remember: - K_m is a key parameter indicating enzyme affinity. - $[S] = K_m$ results in half the maximum reaction rate.

---

14. Which of the following is NOT a Class 1C anti-arrhythmic drug:

(A) Propafenone

(B) Mexiletine

(C) Flecainide

(D) Moricizine

Correct Answer: (B) Mexiletine

Solution: Step 1: Understanding Class 1C anti-arrhythmic drugs. Class 1C anti-arrhythmic drugs are sodium channel blockers with a strong effect on the cardiac action potential. They are used to manage arrhythmias by slowing conduction and reducing automaticity in the heart. Examples include: - Propafenone, - Flecainide, - Moricizine.

Step 2: Differentiating Mexiletine. Mexiletine is a Class 1B anti-arrhythmic drug, not Class 1C. Class 1B drugs have a weaker effect on the sodium channels and are used for treating ventricular arrhythmias.

Step 3: Comparison with other options. - Option (A): Propafenone is a Class 1C drug. - Option (C): Flecainide is a Class 1C drug. - Option (D): Moricizine is also a Class 1C drug.
Conclusion: Mexiletine, a Class 1B drug, is the correct answer for NOT being a Class 1C anti-arrhythmic.

Quick Tip

Anti-arrhythmic drugs are classified into four main classes based on the Vaughan-Williams classification. Class 1 drugs (sodium channel blockers) are further divided into: - 1A: Moderate sodium blockade (e.g., Quinidine). - 1B: Weak sodium blockade (e.g., Mexiletine). - 1C: Strong sodium blockade (e.g., Flecainide, Propafenone).

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15. Which of the following is an example of physical incompatibility:
(A) Alkaloidal incompatibility
(B) Liquefaction
(C) Drug interaction
(D) Error in dosage form
Correct Answer: (B) Liquefaction
Solution: Step 1: Understanding physical incompatibility. Physical incompatibility occurs when there is a physical change during the preparation or administration of a pharmaceutical product. This can include changes such as precipitation, liquefaction, or immiscibility.
Step 2: Explanation of liquefaction. Liquefaction, a common example of physical incompatibility, occurs when two or more solid substances mix and form a liquid due to the lowering of the melting point. For example, mixing certain powders like camphor and menthol can result in liquefaction.
Step 3: Comparison with other options. - Option (A): Alkaloidal incompatibility is a type of chemical incompatibility. - Option (C): Drug interactions involve chemical or pharmacological incompatibilities. - Option (D): Errors in dosage forms are not considered physical incompatibility but rather formulation errors.
Conclusion: Liquefaction is a clear example of physical incompatibility, making (B) the

correct answer.

Quick Tip

Physical incompatibility often arises due to improper mixing or formulation. Common examples include: - Precipitation (e.g., when mixing certain solutions). - Liquefaction (e.g., camphor and menthol). Always test for physical stability during formulation.

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16. Which of the following is a Partial Fatty acid oxidation (pFox) inhibitor:

(A) Trimetazidine

(B) Atosiban

(C) Verapamil

(D) Nicardipine

Correct Answer: (A) Trimetazidine

Solution: Step 1: Understanding pFox inhibitors. Partial Fatty acid oxidation (pFox) inhibitors, such as Trimetazidine, work by shifting myocardial energy metabolism from fatty acid oxidation to glucose oxidation. This is more oxygen-efficient and helps improve cardiac efficiency, especially in conditions like ischemic heart disease.

Step 2: Explanation of Trimetazidine. Trimetazidine is the prototype pFox inhibitor. It selectively inhibits long-chain 3-ketoacyl-CoA thiolase (an enzyme involved in fatty acid oxidation), thereby enhancing glucose oxidation and reducing myocardial oxygen demand.

Step 3: Comparison with other options. - Option (B): Atosiban is an oxytocin receptor antagonist used in preterm labor, not a pFox inhibitor. - Option (C): Verapamil is a calcium channel blocker used for angina and arrhythmias, not a pFox inhibitor. - Option (D): Nicardipine is also a calcium channel blocker and not related to fatty acid oxidation.

Conclusion: Trimetazidine is the correct answer as a pFox inhibitor.

Quick Tip

pFox inhibitors like Trimetazidine are beneficial in chronic stable angina by improving myocardial energy efficiency. They are often used as adjunct therapy when standard treatments are insufficient.

17. Renin is released from:

(A) Hepatocytes of liver

(B) Beta-cells of pancreas

(C) Microglial cells

(D) Juxtaglomerular cells (JGCs) of kidney

Correct Answer: (D) Juxtaglomerular cells (JGCs) of kidney

Solution: Step 1: Understanding the renin-angiotensin system. Renin is an enzyme secreted by the juxtaglomerular cells (JGCs) of the kidney in response to decreased blood pressure, reduced sodium levels, or sympathetic nervous system activation. It plays a vital role in regulating blood pressure and fluid balance.

Step 2: Mechanism of renin release. Renin converts angiotensinogen (produced by the liver) into angiotensin I, which is then converted into angiotensin II by angiotensin-converting enzyme (ACE). Angiotensin II causes vasoconstriction and stimulates aldosterone secretion, increasing blood pressure.

Step 3: Comparison with other options. - Option (A): Hepatocytes of the liver produce angiotensinogen, not renin. - Option (B): Beta-cells of the pancreas secrete insulin, not renin. - Option (C): Microglial cells are involved in immune functions in the central nervous system.

Conclusion: Renin is specifically released by the juxtaglomerular cells (JGCs) of the kidney, making (D) the correct answer.

Quick Tip

The juxtaglomerular cells of the kidney release renin in response to: 1. Low blood pressure. 2. Low sodium concentration in the distal tubule. 3. Activation of the sympathetic nervous system. This is a key component of the renin-angiotensin-aldosterone system (RAAS).

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18. Which of the following cranial nerve is instrumental in motor function:

(A) Vestibulocochlear

(B) Olfactory

(C) Accessory

(D) Optic

Correct Answer: (C) Accessory

Solution: Step 1: Understanding cranial nerve classifications. Cranial nerves are classified based on their primary functions: 1. Sensory nerves (e.g., Olfactory and Optic) are involved in sensation. 2. Motor nerves (e.g., Accessory) control muscle movements. 3. Mixed nerves (e.g., Facial) have both sensory and motor functions.

Step 2: Role of the accessory nerve. The accessory nerve, also known as cranial nerve XI, is a motor nerve that innervates the sternocleidomastoid and trapezius muscles. It facilitates movements of the head, neck, and shoulders.

Step 3: Comparison with other options. - Option (A): Vestibulocochlear nerve (cranial nerve VIII) is a sensory nerve responsible for hearing and balance. - Option (B): Olfactory nerve (cranial nerve I) is a sensory nerve responsible for the sense of smell. - Option (D): Optic nerve (cranial nerve II) is a sensory nerve responsible for vision.

Conclusion: The accessory nerve (cranial nerve XI) is the correct answer for being instrumental in motor function.

Quick Tip

Cranial nerves involved in motor functions include: 1. Oculomotor (III): Eye movement. 2. Trochlear (IV): Eye movement. 3. Abducens (VI): Eye movement. 4. Accessory (XI): Neck and shoulder movements. 5. Hypoglossal (XII): Tongue movement.

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19. The most common neoplasm in patients with AIDS is:

(A) Carcinoma of breast

(B) Acute myeloid leukaemia

(C) Adenocarcinoma

(D) Kaposi sarcoma

Correct Answer: (D) Kaposi sarcoma

Solution: Step 1: Understanding neoplasms in AIDS patients. Patients with AIDS are

highly immunocompromised due to the depletion of CD4+ T cells. This increases their susceptibility to certain cancers, especially those caused by viral infections.

Step 2: Explanation of Kaposi sarcoma. Kaposi sarcoma is a vascular tumor caused by human herpesvirus-8 (HHV-8). It is the most common neoplasm in AIDS patients and presents as red or purple skin lesions, often involving mucous membranes, lymph nodes, and visceral organs.

Step 3: Comparison with other options. - Option (A): Carcinoma of the breast is not associated with AIDS. - Option (B): Acute myeloid leukemia (AML) is unrelated to AIDS. - Option (C): Adenocarcinomas are less common in AIDS patients compared to Kaposi sarcoma.

Conclusion: Kaposi sarcoma is the most common neoplasm in AIDS patients, making (D) the correct answer.

Quick Tip

Kaposi sarcoma is a hallmark AIDS-defining illness. Early antiretroviral therapy (ART) significantly reduces the risk of developing Kaposi sarcoma and other AIDS-associated malignancies.

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20. The Phase in which two identical copies of DNA are formed is:

(A) M phase

(B) G2 phase

(C) G1 phase

(D) S phase

Correct Answer: (D) S phase

Solution: Step 1: Understanding the phases of the cell cycle. The cell cycle consists of the following phases: 1. G1 phase: The cell grows and prepares for DNA replication. 2. S phase: DNA replication occurs, resulting in the formation of two identical copies of DNA. 3. G2 phase: The cell prepares for mitosis by synthesizing necessary proteins and organelles. 4. M phase: The cell undergoes mitosis and cytokinesis, resulting in two daughter cells.

Step 2: Explanation of DNA replication. During the S phase (synthesis phase), the DNA in

the cell is duplicated, ensuring that each daughter cell receives an identical copy during cell division.

Step 3: Comparison with other options. - Option (A): M phase is the mitotic phase where cell division occurs, not DNA replication. - Option (B): $G2$ phase is for cell growth and preparation for mitosis, not DNA synthesis. - Option (C): $G1$ phase is the initial growth phase before DNA replication.

Conclusion: DNA replication occurs in the S phase, making (D) the correct answer.

Quick Tip

The S phase is critical for genetic continuity during cell division. Errors in DNA replication during this phase can lead to mutations or chromosomal abnormalities.

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21. Progressive loss of bone that occurs in osteoporosis is an example of:

(A) Atrophy

(B) Hyperplasia

(C) Hypertrophy

(D) Metaplasia

Correct Answer: (A) Atrophy

Solution: Step 1: Understanding atrophy. Atrophy is the reduction in the size or number of cells, tissues, or organs, often resulting in diminished function. In osteoporosis, the loss of bone mass occurs due to increased bone resorption and decreased bone formation, leading to reduced bone density and strength.

Step 2: Comparison with other options. - Option (B): Hyperplasia refers to an increase in the number of cells, which does not occur in osteoporosis. - Option (C): Hypertrophy refers to an increase in cell size, not cell loss. - Option (D): Metaplasia refers to the replacement of one cell type with another, which is unrelated to osteoporosis.

Step 3: Explanation of osteoporosis. Osteoporosis is a systemic skeletal condition characterized by decreased bone density and microarchitectural deterioration of bone tissue, leading to fragility fractures. This condition exemplifies atrophy due to the progressive loss of bone tissue.

Conclusion: Progressive bone loss in osteoporosis is a clear example of (A) Atrophy.

Quick Tip

Osteoporosis can be prevented and managed by: 1. Adequate calcium and vitamin D intake. 2. Regular weight-bearing exercises. 3. Medications like bisphosphonates to reduce bone resorption.

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22. The visible coloured ring of the eye is called:

(A) Lens

(B) Retina

(C) Cornea

(D) Iris

Correct Answer: (D) Iris

Solution: Step 1: Understanding the anatomy of the eye. The iris is the colored, circular structure in the eye that surrounds the pupil. It controls the amount of light entering the eye by adjusting the size of the pupil.

Step 2: Comparison with other options. - Option (A): The lens is a transparent, biconvex structure behind the iris that focuses light onto the retina. - Option (B): The retina is the light-sensitive layer at the back of the eye responsible for converting light into neural signals. - Option (C): The cornea is the clear, dome-shaped surface that covers the front of the eye and refracts light.

Step 3: Conclusion. The visible colored part of the eye is the iris, making (D) the correct answer.

Quick Tip

The color of the iris is determined by the amount and type of pigment (melanin) it contains. It varies among individuals and can range from brown to blue, green, or gray.

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23. Sarcoma is the cancer of:

(A) Plasma cells

(B) Glands

(C) Connective tissues

(D) Epithelium

Correct Answer: (C) Connective tissues

Solution: Step 1: Definition of sarcoma. Sarcoma is a type of cancer that originates in connective tissues such as bones, muscles, fat, cartilage, and blood vessels. These tissues provide structural and functional support to the body.

Step 2: Comparison with other options. - Option (A): Plasma cell cancers, such as multiple myeloma, are not sarcomas. - Option (B): Glandular cancers, such as adenocarcinomas, originate in epithelial tissues of glands. - Option (D): Epithelial cancers, called carcinomas, originate in the epithelium, not connective tissues.

Step 3: Conclusion. Sarcoma specifically refers to cancers arising from connective tissues, making (C) the correct answer.

Quick Tip

Sarcomas are less common than carcinomas and are typically categorized into: 1. Bone sarcomas: E.g., osteosarcoma. 2. Soft tissue sarcomas: E.g., liposarcoma, leiomyosarcoma. Early detection improves treatment outcomes.

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24. Outer covering of the testes is:

(A) Tunica albuginea

(B) Tunica vaginalis

(C) Tunica media

(D) Tunica vasculosa

Correct Answer: (B) Tunica vaginalis

Solution: Step 1: Anatomy of the testes. The testes are covered by multiple layers for protection and structural integrity: 1. Tunica vaginalis: The outermost layer derived from the peritoneum. 2. Tunica albuginea: A dense fibrous layer beneath the tunica vaginalis, providing support. 3. Tunica vasculosa: The innermost vascular layer.

Step 2: Explanation of tunica vaginalis. The tunica vaginalis is a double-layered serous

membrane covering the testes. It reduces friction and provides protection during movement.

Step 3: Comparison with other options. - Option (A): Tunica albuginea is a fibrous layer located beneath the tunica vaginalis. - Option (C): Tunica media is not related to the testes; it refers to a layer in blood vessels. - Option (D): Tunica vasculosa is the innermost vascular layer of the testes.

Conclusion: The outer covering of the testes is (B) Tunica vaginalis.

Quick Tip

The testes are surrounded by three layers: 1. Tunica vaginalis: Outermost protective layer. 2. Tunica albuginea: Provides structural support. 3. Tunica vasculosa: Supplies blood to the testes. Understanding these layers is crucial in diagnosing testicular pathologies.

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25. Which of the following is the best technique for detecting HIV:

(A) Widal test

(B) Real-time PCR

(C) Polymerase chain reaction

(D) Reverse transcriptase-PCR

Correct Answer: (D) Reverse transcriptase-PCR

Solution: Step 1: Understanding HIV detection techniques. HIV detection requires identifying viral RNA or DNA in the patient's blood. Among the given options, reverse transcriptase-PCR (RT-PCR) is the most specific and sensitive method. It involves converting viral RNA into complementary DNA (cDNA) using reverse transcriptase, followed by amplification using PCR.

Step 2: Comparison with other options. - Option (A): The Widal test is used for typhoid diagnosis, not HIV. - Option (B): Real-time PCR can be used but does not specifically include the reverse transcription step essential for RNA viruses like HIV. - Option (C): Standard PCR amplifies DNA but cannot process RNA directly without reverse transcription.

Conclusion: RT-PCR is the best technique for detecting HIV, as it specifically amplifies viral RNA, making (D) the correct answer.

Quick Tip

HIV testing methods include: 1. ELISA: For initial screening. 2. Western blot: For confirmation. 3. RT-PCR: Highly sensitive for detecting viral RNA, especially in early stages of infection.
