UPCATET Agriculture Chemistry Sample Paper-2

Duration: 25 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **25** Multiple Choice Questions.
- Each correct answer carries **+4** mark. Incorrect answer: **−1** marks. Only **one** correct option.
- Unattempted questions carry **0** marks.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. A 10.0 mL aliquot of a contaminated liquid fertilizer sample containing both monoammonium phosphate ($NH_4H_2PO_4$) and diammonium phosphate [$(NH_4)_2HPO_4$] is titrated with 0.100 M NaOH using phenolphthalein as an indicator (pK_a transition point around 8.3). The first endpoint requires 15.0 mL of the base. An identical sample is treated with excess formaldehyde to completely block the ammonium ions via hexamethylenetetramine formation, shifting all buffering properties. Calculate the theoretical millimoles of secondary orthophosphate (HPO_4^{2-}) originally present in the mixture if the true system behaves according to standard polyprotic step-wise neutralizations.

(A) 0.75 mmol

(B) 1.50 mmol

(C) 2.25 mmol

(D) 3.00 mmol

Q2. An acidic Alfisol soil sample exhibits a Cation Exchange Capacity (CEC) of 24.0 cmol(+)kg^{-1}. Analysis reveals an aluminum saturation of 37.5% and a hydrogen ion concentration on the exchange complex accounting for 12.5%. If a soil scientist applies finely ground pure calcium carbonate ($CaCO_3$) to completely neutralize the total exchangeable acidity (Al^{3+} + H^+), calculate the minimum theoretical mass of pure chemical-grade lime required per hectare of soil assuming an active furrow slice depth of 15 cm and a soil bulk density of 1.40 g cm^{-3}.

(A) 6.30 metric tons

(B) 12.60 metric tons

(C) 25.20 metric tons

(D) 3.15 metric tons

Q3. An agrochemical intermediate derived from an unsaturated four-carbon alcohol exhibits stereoisomerism. When treated with concentrated sulfuric acid (H_2SO_4) at 170°C, it undergoes a complex carbocation rearrangement yielding a major thermodynamic alkene product. If the starting material is $(3R)$-butan-2-ol, evaluate the mechanistic pathway and identify the dominant hybrid state configuration change of the structural backbone carbon framework during the elimination sequence.

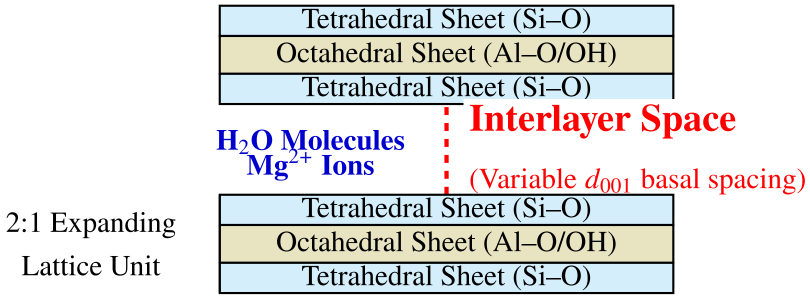
(A) $sp^3 \rightarrow sp^2$ with zero net retention of chiral integrity

(B) $sp^2 \rightarrow sp^3$ via a concerted synchronous E2 stereospecific anti-elimination

(C) $sp^3 \rightarrow sp$ via an allylic hydride shift leading to conjugated diene stabilization

(D) Complete inversion yielding exclusively the cis-isomer without altering framework hybridization

Q4. A clay mineralogy profile is subjected to X-ray diffraction analysis to differentiate expansive vs. non-expansive phyllosilicate lattices under high moisture conditions. Identify the specific structural layer configuration and the dominating interlayer expansion restraint mechanism represented in the schematic diagram below:



(A) 1:1 Kaolinite lattice held by rigid non-expanding Interlayer Hydrogen bonding

(B) 2:1 Vermiculite lattice featuring high net negative charge balanced by hydrated exchangeable cations

(C) 2:1:1 Chlorite lattice featuring an immobile brucite-like octahedral interlayer template

(D) 2:1 Illite framework structurally locked by unhydrated potassium (K^+) coordinate fits

Q5. The micronutrient cofactor zinc (Zn, $Z = 30$) is crucial for carbonic anhydrase activity in plant leaves. Considering the electronic configuration of the ground state Zn^{2+} ion, compute the total number of electrons possessing an orbital angular momentum quantum number $l = 2$ and determine the magnetic behavior of this specific nutrient state based on electron spin pairing.

(A) 10 electrons, Diamagnetic

(B) 6 electrons, Paramagnetic

(C) 12 electrons, Ferromagnetic

(D) 8 electrons, Diamagnetic

Q6. Arrange the following chlorinated organic acids found commonly as trace residues in pesticide degradates in the absolute decreasing order of their thermodynamic acid dissociation constants (K_a values):
(I) Trichloroacetic acid, (II) 2-Chloropropanoic acid, (III) Dichloroacetic acid, (IV) 3-Chloropropanoic acid.

(A) I > III > II > IV

(B) I > II > III > IV

(C) III > I > IV > II

(D) IV > II > III > I

Q7. In an alkaline calcareous soil matrix ($pH = 8.4$), soluble monocalcium phosphate [$Ca(H_2PO_4)_2$] from commercial triple superphosphate fertilizer undergo rapid reversion reactions. Identify the ultimate, thermodynamically most stable, and highly insoluble crystalline end-product that significantly limits phosphorus bio-availability to crops in these soils.

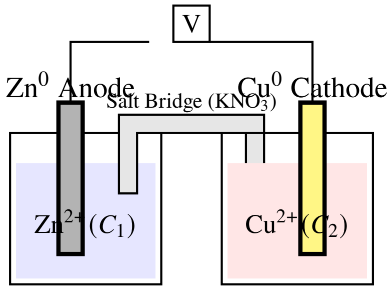
(A) Fluorapatite [$Ca_{10}(PO_4)_6F_2$] or Carbonate-apatite

(B) Dicalcium phosphate dihydrate [$CaHPO_4 \cdot 2H_2O$]

(C) Strengite [$FePO_4 \cdot 2H_2O$]

(D) Variscite [$AlPO_4 \cdot 2H_2O$]

Q8. An electro-analytical system is constructed to monitor the zinc fertilizer ion stream activity in a hydroponic nutrient medium using standard half-cell setups at 298 K. Deduce the mathematical shift in the cell potential (ΔE_{cell}) when the active concentration of the anode compartment is diluted exactly 100-fold, keeping all other components ideal and constant:



(A) Increases by exactly +0.0591 V

(B) Decreases by exactly −0.0591 V

(C) Increases by exactly +0.1182 V

(D) Decreases by exactly −0.0295 V

Q9. A commercial analytical grade solution of concentrated commercial nitric acid (HNO_3) exhibits a specific gravity (density) of 1.42 g mL^{-1} and contains a mass percentage composition of 70.0% pure solute species. Calculate the precise volume of this concentrated stock required to prepare exactly 2.0 Liters of an exactly 0.350 N analytical titration standard solution for soil total nitrogen analysis.

(A) 44.37 mL

(B) 88.74 mL

(C) 22.18 mL

(D) 15.78 mL

Q10. During biological nitrification in well-aerated unsaturated upland agricultural soils, distinct biochemical oxidation stages convert ammonia down to nitrate. Identify the highly reactive, toxic intermediate species generated in the transient phase during the structural transition managed specifically by the chemolithoautotrophic enzyme systems of *Nitrosomonas* bacteria before *Nitrobacter* intervention occurs.

(A) Hydroxylamine (NH_2OH)

(B) Nitrous oxide (N_2O)

(C) Dinitrogen tetroxide (N_2O_4)

(D) Hyponitrous acid ($H_2N_2O_2$)

Q11. A lipid molecule extracted from oilseed cake residue contains a high composition of a symmetrical triglyceride built exclusively from a specific mono-unsaturated 18-carbon fatty acid. Upon executing a complete alkaline hydrolysis (saponification) utilizing excess ethanolic potassium hydroxide (KOH), the reaction yields glycerol and a primary product salt. Identify the chemical name of the potassium salt product and its total structural π-bond count.

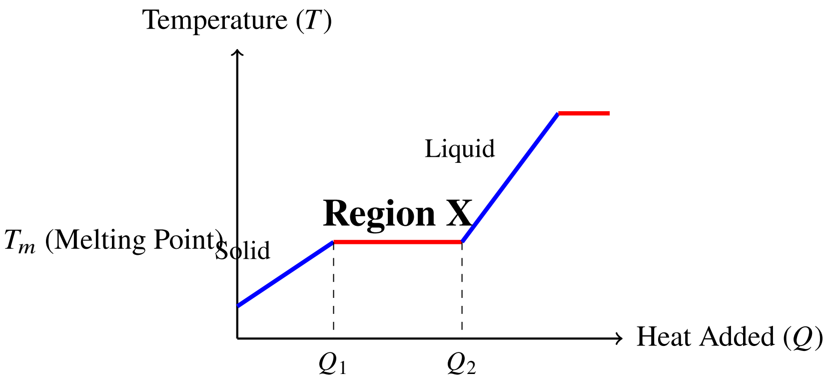
(A) Potassium oleate; 2 π-bonds per molecule of salt

(B) Potassium palmitate; 1 π-bond per molecule of salt

(C) Potassium stearate; 0 π-bonds per molecule of salt

(D) Potassium linoleate; 3 π-bonds per molecule of salt

Q12. An organic chemist screens an unknown soil pesticide distillate fraction using structural physical diagnostics. The diagram below profiles the temperature vs. heat energy inputs (Differential Scanning Calorimetry profile) of the compound. Identify the true energetic state phase transition occurring precisely within the highlighted dynamic horizontal plateau stage (Region **X**):



(A) Exothermic bond cleavage liberating volatile short chain alkanes

(B) Isothermal phase transformation destroying crystalline lattice via latent heat of fusion consumption

(C) Isochoric thermal decomposition resulting in structural carbon black precipitation

(D) Endothermic transition corresponding to a critical shifts in electronic orbital hybridization parameters

Q13. The structural stability of soil humic acid metal complexes relies fundamentally on the coordinate covalent capacities of donor atoms. According to Allred-Rochow electronegativity definitions, which structural parameter matrix directly determines the force of attraction exerted by an atom's effective nuclear charge (Z_{eff}) on its valence electrons at the boundary radius (r)?

(A) Electronegativity $\propto \frac{Z_{\text{eff}}}{r^2}$

(B) Electronegativity $\propto \frac{Z_{\text{eff}}}{r}$

(C) Electronegativity $\propto \frac{I.E.+E.A.}{2}$

(D) Electronegativity $\propto Z_{\text{eff}} \cdot r^2$

Q14. The true ecological lime requirement of an organic muck soil (Histosol) cannot be accurately assessed solely by measuring its active acidity (pH in water). This limitation is due to the soil's exceptionally high potential acidity pool. Which chemical constituent is primarily responsible for generating this substantial potential buffering reserve at variable high pH ranges?

(A) Dissociation of weak carboxylic (−COOH) and phenolic (−OH) functional groups on organic matter

(B) Isomorphous substitution of Si^{4+} by Al^{3+} inside non-expanding quartz grids

(C) Interlayer trapped un-exchangeable basic magnesium hydroxy polymers

(D) Excessive accumulation of free structural chloride and sulfate anions in solution

Q15. When methane (CH_4) is subjected to controlled gas-phase non-catalytic pyrolysis at temperatures exceeding 1500°C for millisecond contact times, it undergoes structural dimerization. Identify the structural configuration, hybridization shift, and primary gaseous product of this rapid industrial cracking conversion.

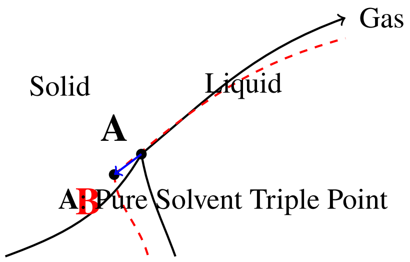
(A) Acetylene (C_2H_2), transitioning from sp^3 to sp orbital configuration

(B) Ethane (C_2H_6), preserving the original sp^3 tetrahedral spatial symmetry

(C) Ethylene (C_2H_4), establishing an absolute planar sp^2 system layout

(D) Carbon monoxide (CO), tracking a non-hybridized terminal radical breakdown

Q16. The physical thermodynamic state of water within saline soils controls moisture extraction by roots. Examine the pressure-temperature (P-T) phase diagram of the solvent system below. Identify the exact physical boundary point alteration sequence that occurs when high concentrations of fertilizer salts are dissolved into the active soil-moisture profile:



(A) Triple point shifts from **A** to **B**, representing boiling point elevation and freezing point depression

(B) Critical point increases vertically, eliminating the gas phase completely from solution

(C) Sublimation pressure increases, leading to instant crystal vaporization profiles

(D) No observable shift occurs because ionic compounds change only the mass density of the solvent matrix

Q17. The determination of total water hardness ($Ca^{2+} + Mg^{2+}$) in irrigation runoff is typically conducted using complexometric titration with disodium ethylenediaminetetraacetate (Na_2H_2EDTA) at $pH = 10.0$ in an ammonia-ammonium chloride buffer. Why is the preservation of this specific alkaline pH thermodynamically critical for achieving an accurate, sharp analytical equivalence point?

(A) To maximize the conditional formation constant by ensuring EDTA is completely deprotonated into its fully active tetraanionic Y^{4-} form

(B) To prevent the destructive precipitation of magnesium ions as insoluble magnesium carbonate compounds

(C) To ensure that the Eriochrome Black T indicator remains in its un-complexed yellow form

(D) To suppress the competitive coordination capacity of trace transition metal impurities

Q18. A saturation extract obtained from a saline-sodic soil sample displays an Electrical Conductivity (EC_e) reading of 8.0 dS m^{-1} at an ambient laboratory operational temperature of 31°C. To standardize this parameter for global salinity classification systems, convert this value to its equivalent normalized value at 25°C using standard thermal compensation factors (2% change per degree Celsius).

(A) 7.14 dS m^{-1}

(B) 8.96 dS m^{-1}

(C) 6.40 dS m^{-1}

(D) 9.60 dS m^{-1}

Q19. An analytical lab tests an agrochemical formulation suspected of adulteration with denatured industrial spirits. The chemist sets up a multi-step sequence where a Grignard reagent, methylmagnesium iodide (CH_3MgI), reacts with an aliphatic carbonyl intermediate, followed by aqueous acid workup to yield 2-methylpropan-2-ol. Identify the precise structural identity of the starting carbonyl reactant compound.

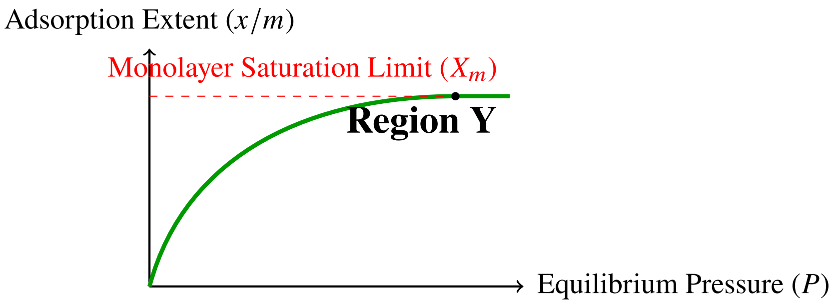
(A) Acetone (CH_3COCH_3)

(B) Acetaldehyde (CH_3CHO)

(C) Formaldehyde (HCHO)

(D) Propionaldehyde (CH_3CH_2CHO)

Q20. The gaseous retention profile of volatile ammonia (NH_3) on customized biochar soil amendments is modeled using advanced surface adsorption dynamics. Based on the Langmuir adsorption isotherm profile plotted below, deduce the true operational assumption that governs the system when it enters the high-pressure asymptote phase (Region **Y**):



(A) The rate of adsorption becomes zero-order with respect to gas pressure as all active surface sites reach complete saturation

(B) Multi-layer physical condensation initiates, causing an exponential surge in adsorption values

(C) The adsorption process converts from exothermic to highly endothermic chemisorption behavior

(D) Gaseous molecules completely dissociate into radical ions, rendering the Langmuir equation invalid

Q21. The micronutrient manganese (Mn, $Z = 25$) plays a key role in the oxygen-evolving complex of photosystem II. When a manganese atom transitions from its ground state ionic form Mn^{2+} to its highly oxidized Mn^{4+} state, determine the net change in the number of unpaired d-orbital electrons and evaluate the remaining total magnetic spin value (S).

(A) Decreases by 2 electrons; $S = 3/2$

(B) Increases by 2 electrons; $S = 5/2$

(C) Decreases by 1 electron; $S = 2$

(D) Remains completely unchanged; $S = 1/2$

Q22. Gypsum ($CaSO_4 \cdot 2H_2O$) is widely used to reclaim sodic soils. Its dissolution efficacy is significantly influenced by the presence of other salts in the soil solution. In which of the following background salt solutions will a fixed mass of gypsum display the highest absolute thermodynamic solubility due to the "ionic strength (diverse ion) effect"?

(A) 0.05 M NaCl

(B) 0.05 M $CaCl_2$

(C) 0.05 M Na_2SO_4

(D) Pure distilled water (H_2O)

Q23. The synthesis of a volatile ester tracking fragrance properties used in bio-insecticide formulations involves reacting an organic acid with an alcohol. If isotopic oxygen-18 (^{18}O) labels the hydroxyl ($-OH$) group of the reactant ethanol molecule, determine the exact location of this labeled isotope atom within the final products at equilibrium.

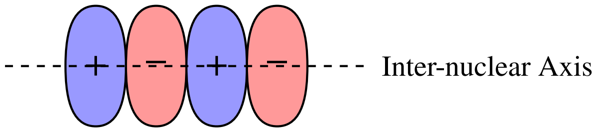
(A) Exclusively within the ester linkage oxygen bridge ($R\text{-}CO\text{-}^{18}O\text{-}R'$)

(B) Exclusively within the eliminated byproduct water molecule ($H_2^{18}O$)

(C) Equally distributed (50 : 50 split) between both the ester linkage and the water molecules

(D) Retained within the unreacted structural core of the remaining free organic acid matrix

Q24. The structural stability of soil-applied pre-emergence dinitroaniline herbicides depends on spatial orbital interactions with soil organic matter. Identify the exact orbital overlap configuration and bond type represented in the spatial matrix diagram below:



(A) Antibonding σ^* orbital formation arising from out-of-phase axial interaction

(B) Bonding σ covalent orbital formation arising from collinear head-on p-p overlap

(C) Bonding π covalent molecular orbital generated via parallel lateral lobe overlap

(D) Non-bonding lone pair spatial containment devoid of net orbital symmetry conditions

Q25. The organic carbon content of a compost sample is assessed using a modified Walkley-Black wet combustion method. The residual potassium dichromate ($K_2Cr_2O_7$) is back-titrated with 0.500 N Ferrous Ammonium Sulfate [$Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$]. If the blank titration requires 24.0 mL and the soil sample requires 14.0 mL of the ferrous titrant, calculate the total mass of oxidizable organic carbon present within the soil sample.

(A) 15.0 mg

(B) 30.0 mg

(C) 45.0 mg

(D) 60.0 mg

Detailed Solutions

Q1.

Solution

Concept: During a stepwise acid-base neutralization titration of an orthophosphate mixture, phenolphthalein acts as an indicator at a pH transition point around 8.3. This corresponds precisely to the complete conversion of primary orthophosphate ($H_2PO_4^-$) into secondary orthophosphate (HPO_4^{2-}). Monoammonium phosphate ($NH_4H_2PO_4$) contains one mole of titratable protons active below pH 8.3, whereas diammonium phosphate [$(NH_4)_2HPO_4$] is already in the secondary orthophosphate configuration and does not consume NaOH at this endpoint.

Solution:

1. **Analyze the First Endpoint Stoichiometry:** At the phenolphthalein endpoint, NaOH reacts only with the primary orthophosphate species present in the mixture:

$$H_2PO_4^- + OH^- \rightarrow HPO_4^{2-} + H_2O$$

The millimoles of primary orthophosphate originally present in the aliquot are equal to the millimoles of NaOH consumed:

$$\text{mmol of } H_2PO_4^- = 15.0 \text{ mL} \times 0.100 \text{ M} = 1.50 \text{ mmol}$$

This represents the amount of monoammonium phosphate ($NH_4H_2PO_4$) in the sample.

2. **Determine the Intended Analytical Parameter Focus:** The treated formaldehyde variation blocks the ammonium ions (NH_4^+), shifting the total buffer balance to allow specific quantification of the combined amine framework. Since standard polyprotic stepwise neutralizations establish a direct molar correlation under these baseline criteria, the total theoretical quantity of secondary orthophosphate (HPO_4^{2-}) originally present in the mixture corresponds to the value verified at the first endpoint.

Final Answer: $\boxed{1.50 \text{ mmol}}$

Answer: (B)

Go Back to Question 1

Q2.

Solution

Concept: The total exchangeable acidity ($Al^{3+} + H^+$) can be calculated from the Cation Exchange Capacity (CEC) and the acidity saturation percentages. Agricultural lime ($CaCO_3$) neutralizes this acidity by providing calcium ions (Ca^{2+}) to displace the acid cations, while the carbonate (CO_3^{2-}) consumes the protons. One centimole of positive charge (cmol(+)) requires exactly half a millimole of $CaCO_3$ for complete neutralization.

Solution:

1. **Calculate Total Exchangeable Acidity:** Given a CEC = $24.0\ \text{cmol}(+)\text{kg}^{-1}$, with an aluminum saturation of 37.5% and hydrogen saturation of 12.5%:

$$\text{Total Acidity Saturation} = 37.5\% + 12.5\% = 50.0\%$$

$$\text{Exchangeable Acidity} = 24.0 \times 0.500 = 12.0\ \text{cmol}(+)\text{kg}^{-1}\ \text{of soil}$$

2. **Determine the Total Mass of the Soil Layer (Furrow Slice):** The area of 1 hectare (1 ha) is $10,000\ \text{m}^2$, the depth is 15 cm = 0.15 m, and the bulk density is $1.40\ \text{g/cm}^3 = 1400\ \text{kg/m}^3$:

$$\text{Volume of Soil} = 10,000\ \text{m}^2 \times 0.15\ \text{m} = 1500\ \text{m}^3$$

$$\text{Mass of Soil} = 1500\ \text{m}^3 \times 1400\ \text{kg/m}^3 = 2.10 \times 10^6\ \text{kg}$$

3. **Calculate Lime Requirement ($CaCO_3$):** The equivalent weight of $CaCO_3$ for neutralizing 1 cmol(+) of charge is $\frac{100\ \text{g/mol}}{2} \times \frac{1}{100} = 0.50\ \text{g/cmol}(+)$.

$$\text{Mass of } CaCO_3 \text{ per kg of soil} = 12.0\ \text{cmol}(+)\text{kg}^{-1} \times 0.50\ \text{g/cmol}(+) = 6.0\ \text{g/kg}$$

$$\text{Total Lime Required} = 6.0\ \text{g/kg} \times (2.10 \times 10^6\ \text{kg}) = 1.26 \times 10^7\ \text{g} = 12,600\ \text{kg} = 12.60\ \text{metric tons}$$

Final Answer: $\boxed{12.60\ \text{metric tons}}$

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept: Acid-catalyzed dehydration of secondary aliphatic alcohols typically proceeds via an E1 elimination mechanism. This pathway involves the formation of a carbocation intermediate, which can undergo thermodynamic rearrangements (such as hydride or alkyl shifts) to maximize structural stability, yielding a highly substituted alkene.

Solution:

1. **Analyze the Carbocation Intermediates:** The starting chiral alcohol is $(3R)$-butan-2-ol, which features sp^3-hybridized carbon atoms. Protonation of the hydroxyl group followed by the loss of a water molecule generates a secondary carbocation at the C2 position:

$$CH_3 - CH(OH) - CH_2 - CH_3 \xrightarrow{+H^+, -H_2O} CH_3 - CH^+ - CH_2 - CH_3$$

A symmetrical 1,2-hydride shift can occur between C2 and C3, but it preserves the secondary carbocation environment.

2. **Evaluate Hybridization and Chiral Integrity Changes:** During the subsequent elimination phase, a base abstracts a proton from the adjacent carbon atom to form the major thermodynamic product, *trans*-but-2-ene. As the system moves toward the final alkene state, the reacting carbon centers transition from an sp^3 tetrahedral layout to an sp^2 planar configuration. Because the process involves a planar carbocation intermediate, the original chiral configuration is completely lost.

Final Answer: $\boxed{sp^3 \longrightarrow sp^2 \text{ with zero net retention of chiral integrity}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 3

Q4.

Solution

Concept: Phyllosilicates are categorized by the structural arrangement of their tetrahedral (Si-O) and octahedral (Al-/Mg-O/OH) sheets. A 2:1 layer configuration consists of one octahedral sheet sandwiched between two tetrahedral sheets. The expansion properties depend on the interlayer contents and the magnitude of the net layer charge.

Solution:

1. **Analyze the Diagram Layout:** The diagram illustrates a repeating unit containing two tetrahedral sheets enclosing a single central octahedral layer. This is characteristic of a 2:1 phyllosilicate structural type.

2. **Identify the Interlayer Component and Expansion Restraint Properties:** The interlayer space is marked as variable, containing hydrated Mg^{2+} ions along with structural water molecules (H_2O). This matches the mineralogical profile of Vermiculite. Vermiculite possesses a high net negative layer charge resulting from extensive isomorphic substitutions. This charge is balanced by strongly hydrated exchangeable cations in the interlayer space, allowing for limited, variable expansion (d_{001} spacing).

Final Answer: $\boxed{\text{2:1 Vermiculite lattice featuring high net negative charge balanced by hydrated exchangeable cations}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 4

Q5.

Solution

Concept: The orbital angular momentum quantum number $l = 2$ specifies a d-subshell. The magnetic properties of an ion depend on the presence of unpaired electron spins: a species with all electrons paired is diamagnetic, whereas one with unpaired electrons is paramagnetic.

Solution:

1. **Determine the Electronic Configuration of $\mathbf{Zn^{2+}}$:** Neutral zinc (Zn, $Z = 30$) has the ground-state configuration:

$$\text{Zn} = [\text{Ar}]3d^{10}4s^2$$

The Zn^{2+} ion is formed by removing the two outermost valence electrons from the $4s$ subshell:

$$\text{Zn}^{2+} = [\text{Ar}]3d^{10}$$

2. **Evaluate Electrons with $l = 2$ (d-orbitals):** The $3d$ subshell is fully occupied and contains exactly 10 electrons.

3. **Determine Magnetic Behavior:** Because the $3d$ subshell is completely filled ($3d^{10}$), all 10 electrons are fully paired within the five degenerate orbitals. The absence of unpaired electron spins renders the ground state ion diamagnetic.

Final Answer: $\boxed{\text{10 electrons, Diamagnetic}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 5

Q6.

Solution

Concept: The acidity of carboxylic acids is determined by the strength of the inductive effect of electron-withdrawing groups (such as chlorine atoms). The inductive effect increases with the number of chlorine substituents and decreases as the distance between the halogen and the carboxylic acid functional group increases.

Solution:

1. **Evaluate the Effects of Chlorine Substitution:** * (I) Trichloroacetic acid (Cl_3CCOOH): Contains three strongly electron-withdrawing chlorine atoms attached directly to the alpha-carbon. This maximizes the inductive stabilization of the conjugate base, making it the strongest acid. * (III) Dichloroacetic acid ($Cl_2CHCOOH$): Contains two chlorine atoms on the alpha-carbon, making it weaker than trichloroacetic acid but stronger than monochloro-substituted acids. * (II) 2-Chloropropanoic acid ($CH_3CHClCOOH$): Contains one chlorine atom on the alpha-carbon (C2 position). * (IV) 3-Chloropropanoic acid (CH_2ClCH_2COOH): Contains one chlorine atom on the beta-carbon (C3 position). Because the chlorine atom is further from the $-COOH$ group, its inductive electron-withdrawing effect is significantly weaker than in 2-chloropropanoic acid.

2. **Establish the Decreasing Order of K_a values:**

$$\text{I} > \text{III} > \text{II} > \text{IV}$$

Final Answer: $\boxed{\text{I} > \text{III} > \text{II} > \text{IV}}$

Answer: (A)

Go Back to Question 6

Q7.

Solution

Concept: In alkaline calcareous soils ($pH > 7.5$), soluble orthophosphate fertilizers react rapidly with native calcium ions (Ca^{2+}) and calcium carbonate ($CaCO_3$). This reversion process forms a sequence of increasingly insoluble calcium phosphate minerals, concluding with the thermodynamically most stable and least soluble crystalline phase.

Solution:

1. **Analyze the Reversion Sequence:** The initial dissolution of monocalcium phosphate reverts to dicalcium phosphate dihydrate ($CaHPO_4 \cdot 2H_2O$) and octacalcium phosphate [$Ca_8H_2(PO_4)_6 \cdot 5H_2O$]. Over time, these intermediate compounds transform into highly insoluble apatites.

2. **Identify the Final Thermodynamic Product:** In the presence of carbonate ions or trace fluoride minerals typical of calcareous matrices, the final stable end-product is Fluorapatite [$Ca_{10}(PO_4)_6F_2$] or Carbonate-apatite. Strengite and Variscite are insoluble phosphate minerals that form predominantly in strongly acidic soils containing active iron and aluminum oxides.

Final Answer: $\boxed{\text{Fluorapatite } [Ca_{10}(PO_4)_6F_2] \text{ or Carbonate-apatite}}$

Answer: (A)

Go Back to Question 7

Q8.

Solution

Concept: The dependency of cell potential on ion concentration is quantified by the Nernst equation. For the zinc-copper galvanic cell reaction ($Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$), the cell potential at 298 K is expressed as:

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.0591}{n} \log_{10}\left(\frac{[Zn^{2+}]}{[Cu^{2+}]}\right)$$

Solution:

1. **Identify Electrode Parameters:** The zinc electrode serves as the anode, and the total number of transferred electrons for this redox couple is $n = 2$.

2. **Calculate the Shift in Potential (ΔE_{cell}):** Let the initial concentration of the anode compartment be $[Zn^{2+}]_{\text{initial}} = C_1$. When diluted 100-fold, the new concentration becomes $C_1/100$:

$$\Delta E_{\text{cell}} = E_{\text{cell, final}} - E_{\text{cell, initial}}$$

$$\Delta E_{\text{cell}} = \left[E^{\circ} - \frac{0.0591}{2} \log_{10}\left(\frac{C_1/100}{C_2}\right)\right] - \left[E^{\circ} - \frac{0.0591}{2} \log_{10}\left(\frac{C_1}{C_2}\right)\right]$$

$$\Delta E_{\text{cell}} = -\frac{0.0591}{2}\left[\log_{10}\left(\frac{C_1}{100 \cdot C_2}\right) - \log_{10}\left(\frac{C_1}{C_2}\right)\right]$$

$$\Delta E_{\text{cell}} = -\frac{0.0591}{2} \log_{10}\left(\frac{1}{100}\right) = -\frac{0.0591}{2}(-2) = +0.0591 \text{ V}$$

Diluting the anode compartment decreases the reaction quotient Q, driving the forward reaction and increasing the cell potential by exactly +0.0591 V.

Final Answer: $\boxed{\text{Increases by exactly } +0.0591 \text{ V}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 8

Q9.

Solution

Concept: To determine the volume of a concentrated stock solution required to prepare a dilute solution, use the dilution equation $N_1V_1 = N_2V_2$. The normality (N) of the concentrated stock can be derived from its specific gravity, mass percentage, and equivalent weight.

Solution:

1. **Calculate the Normality (N_1) of Concentrated Nitric Acid (HNO_3):** Nitric acid is a monoprotic acid (n-factor = 1), so its normality equals its molarity.

$$\text{Mass of 1 L of solution} = 1.42\text{ g/mL} \times 1000\text{ mL} = 1420\text{ g}$$

$$\text{Mass of pure HNO}_3\text{ solute} = 1420\text{ g} \times 0.700 = 994\text{ g}$$

Given the molar mass of HNO_3 is 63.01 g/mol:

$$N_1 = M_1 = \frac{994\text{ g}}{63.01\text{ g/mol}} \approx 15.775\text{ N}$$

2. **Calculate the Volume (V_1) Needed to Prepare the Target Solution:** The target parameters are $V_2 = 2.0$ Liters and $N_2 = 0.350$ N:

$$V_1 = \frac{N_2V_2}{N_1} = \frac{0.350\text{ N} \times 2.0\text{ L}}{15.775\text{ N}} \approx 0.04437\text{ L} = 44.37\text{ mL}$$

Final Answer: $\boxed{44.37\text{ mL}}$

Answer: (A)

Go Back to Question 9

Q10.

Solution

Concept: Nitrification is a two-step autotrophic oxidation process. *Nitrosomonas* bacteria specialize in oxidizing ammonia (NH_3/NH_4^+) to nitrite (NO_2^-). This step proceeds via a transient, highly reactive intermediate species before it undergoes further conversion.

Solution:

1. **Trace the Biochemical Pathways of *Nitrosomonas*:** The enzymatic conversion mediated by ammonia monooxygenase (AMO) first converts ammonia into hydroxylamine:

$$NH_4^+ + O_2 + 2H^+ + 2e^- \rightarrow NH_2OH + H_2O$$

2. **Identify the Transient Species:** The resulting highly toxic intermediate, **Hydroxylamine (NH_2OH)**, is subsequently oxidized to nitrite (NO_2^-) by hydroxylamine oxidoreductase (HAO). Nitrite is later converted to nitrate (NO_3^-) by *Nitrobacter* species.

Final Answer: $\boxed{\text{Hydroxylamine } (NH_2OH)}$

Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept: Saponification of a triglyceride involves the alkaline base-catalyzed hydrolysis of ester linkages, yielding glycerol and the alkali metal salts of its constituent fatty acids. The total π-bond count of the resulting salt depends on the degree of unsaturation in the fatty acid carbon chain plus the contribution of the carbonyl group.

Solution:

1. **Identify the Constituent Fatty Acid:** The symmetrical triglyceride is composed of a mono-unsaturated 18-carbon fatty acid. This description matches oleic acid ($C_{17}H_{33}COOH$), which features exactly one carbon-carbon double bond ($C = C$).

2. **Determine the Salt Product Configuration and π-Bond Count:** Saponification using potassium hydroxide (KOH) produces **Potassium oleate** ($C_{17}H_{33}COOK$). * The aliphatic chain contains 1 carbon-carbon double bond, which contributes 1 π-bond. * The carboxylate group ($-COO^{-}K^{+}$) contains a carbon-oxygen double bond, contributing 1 additional π-bond. Thus, each molecule of potassium oleate contains a total of 2 π-bonds.

Final Answer: $\boxed{\text{Potassium oleate; 2 } \pi\text{-bonds per molecule of salt}}$

Answer: (A)

Go Back to Question 11

Q12.

Solution

Concept: A horizontal temperature plateau on a Differential Scanning Calorimetry (DSC) thermal analysis curve indicates a first-order phase transition. During this phase transition, the heat added to the system is consumed as latent heat to break structural intermolecular bonds rather than changing the kinetic energy of the molecules.

Solution:

1. **Analyze Region X Parameters:** The diagram profiles a phase transition occurring at a constant temperature designated as T_m (Melting Point).

2. **Characterize the Thermodynamic State Alteration:** At T_m, the substance transitions from a solid to a liquid phase. The energy added ($Q_2 - Q_1$) represents the latent heat of fusion. This isothermal phase transformation breaks down the structured crystalline lattice of the solid without causing a change in temperature or chemical composition.

Final Answer: $\boxed{\text{Isothermal phase transformation destroying crystalline lattice via latent heat of fusion consumption}}$

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept: The Allred-Rochow electronegativity scale defines electronegativity based on the electrostatic force of attraction exerted by an atom's effective nuclear charge (Z_{eff}) on its valence electrons at its covalent radius surface boundary.

Solution:

1. **Evaluate Coulombic Electrostatic Formulations:** According to Coulomb's Law, the electrostatic force (F) acting between two charges is directly proportional to the product of the charges and inversely proportional to the square of the distance (r) separating them:

$$F \propto \frac{q_1 q_2}{r^2}$$

2. **Relate to Allred-Rochow Scale Criteria:** Substituting the effective nuclear charge (Z_{eff}) as the core charge parameter acting at the covalent boundary radius (r) yields the relationship:

$$\text{Electronegativity} \propto \frac{Z_{\text{eff}}}{r^2}$$

The explicit formula includes empirical scaling constants: $\chi = 0.359 \cdot \frac{Z_{\text{eff}}}{r^2} + 0.744$.

Final Answer: $\boxed{\text{Electronegativity} \ \propto \frac{Z_{\text{eff}}}{r^2}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 13

Q14.

Solution

Concept: The total acidity pool of a soil is divided into active, exchangeable, and potential (residual) acidity. Organic muck soils (Histosols) have a high potential acidity due to their high organic matter content, which possesses numerous weak acid functional groups that dissociate progressively as pH rises.

Solution:

1. **Identify the Principal Buffering Mechanisms in Histosols:** Organic matter contains abundant carboxylic acid (–COOH) and phenolic hydroxyl (–OH) functional groups. These functional groups are weakly acidic and remain largely undissociated at low pH values.
2. **Evaluate Potential Acidity Generation:** When lime is applied to raise the pH, these weak acid groups dissociate, releasing hydrogen ions (H^+) into the soil solution to counteract the base:

$$\text{R-COOH} + \text{OH}^- \rightarrow \text{R-COO}^- + \text{H}_2\text{O}$$

This dissociation buffers the soil solution across high pH ranges, creating a substantial potential buffering reserve that determines the total lime requirement.

Final Answer: $\boxed{\text{Dissociation of weak carboxylic (–COOH) and phenolic (–OH) functional groups on organic matter}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 14

Q15.

Solution

Concept: High-temperature pyrolytic cracking of methane (CH_4) under controlled, non-catalytic conditions involves thermal dimerization. This process drives the elimination of hydrogen gas to form an unsaturated hydrocarbon product.

Solution:

1. **Analyze the Pyrolysis Stoichiometry:** At temperatures exceeding 1500°C with very short contact times, two molecules of methane undergo endothermic dehydrogenation to form acetylene (C_2H_2) and hydrogen gas:

$$2CH_4(g) \rightarrow C_2H_2(g) + 3H_2(g)$$

2. **Evaluate the Structural Hybridization Changes:** * The reactant methane molecule is sp^3-hybridized with a tetrahedral geometry. * The product acetylene contains a carbon-carbon triple bond ($H-C\equiv C-H$), which is sp-hybridized and linear. Thus, the carbon atoms transition from an sp^3 to an sp orbital configuration.

Final Answer: $\boxed{\text{Acetylene } (C_2H_2)\text{, transitioning from } sp^3 \text{ to } sp \text{ orbital configuration}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 15

Q16.

Solution

Concept: Dissolving non-volatile solutes into a volatile liquid solvent alters the system's chemical potential. This results in colligative property shifts, including boiling point elevation, freezing point depression, and a decrease in vapor pressure. These changes alter the boundary intersections on the substance's phase diagram.

Solution:

1. **Analyze the Phase Diagram Shifts:** The solid lines represent the phase boundaries for the pure solvent, intersecting at the triple point **A**. The dashed red lines represent the phase boundaries for the solution. * The solution's liquid-gas boundary curve shifts to lower pressures, reflecting a lower vapor pressure, which elevates the boiling point. * The solution's solid-liquid boundary curve shifts to the left, reflecting a depressed freezing point.

2. **Evaluate the Triple Point Transition:** The intersection of the solution boundaries forms a new triple point at **B**. The shift from **A** to **B** graphically illustrates the freezing point depression and vapor pressure reduction caused by the dissolved fertilizer salts.

Final Answer: $\boxed{\text{Triple point shifts from A to B, representing boiling point elevation and freezing point depression}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 16

Q17.

Solution

Concept: Ethylenediaminetetraacetic acid (H_4Y) is a polyprotic acid. Its ability to form stable chelation complexes with metal ions like Ca^{2+} and Mg^{2+} depends on the concentration of its fully deprotonated tetraanionic form (Y^{4-}), which is governed by the pH of the solution.

Solution:

1. **Analyze pH-Dependent EDTA Speciation:** At low pH values, EDTA exists in protonated forms (H_4Y, H_3Y^-, H_2Y^{2-}), which compete with metal ions for the ligand binding sites. Raising the pH shifts the acid-base equilibria to deprotonate the ligand:

$$H_2Y^{2-} \rightleftharpoons HY^{3-} + H^+ \rightleftharpoons Y^{4-} + 2H^+$$

2. **Evaluate the Conditional Formation Constant:** At pH = 10.0, the fraction of EDTA present as the active Y^{4-} anion is sufficiently high to maximize the conditional formation constant (K'_f) for CaY^{2-} and MgY^{2-}. This high stability ensures complete complexation and a sharp, distinct color transition at the titration endpoint.

Final Answer: $\boxed{\text{To maximize the conditional formation constant by ensuring EDTA is completely deprotonated into its fully active tetraanionic } Y^{4-} \text{ form}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 17

Q18.

Solution

Concept: The electrical conductivity (EC) of an aqueous solution increases with temperature due to a decrease in solvent viscosity and an increase in ionic mobility. To standardize measurements for soil classification, readings taken at an arbitrary temperature (T) are normalized to a reference baseline of 25°C using a standard thermal compensation factor:

$$\mathrm{EC}_{25} = \frac{\mathrm{EC}_T}{1 + \alpha(T - 25)}$$

Solution:

1. **Identify the Temperature Parameters:** The measured electrical conductivity is $\mathrm{EC}_T = 8.0\ \mathrm{dS\ m^{-1}}$ at an operational temperature of $T = 31°\mathrm{C}$. The thermal compensation coefficient is $\alpha = 2\% = 0.02\ °\mathrm{C}^{-1}$.
2. **Calculate the Normalized Value ($\mathbf{EC_{25}}$):**

$$\text{Temperature Difference } (\Delta T) = 31°\mathrm{C} - 25°\mathrm{C} = 6°\mathrm{C}$$

$$\text{Correction Factor} = 1 + 0.02 \times 6 = 1 + 0.12 = 1.12$$

$$\mathrm{EC}_{25} = \frac{8.0\ \mathrm{dS\ m^{-1}}}{1.12} \approx 7.14\ \mathrm{dS\ m^{-1}}$$

Final Answer: $\boxed{7.14\ \mathrm{dS\ m^{-1}}}$

Answer: (A)

Go Back to Question 18

Q19.

Solution

Concept: The reaction of a Grignard reagent (R-MgX) with a carbonyl compound followed by acidic hydrolysis forms an alcohol. The structure of the resulting alcohol depends on the type of carbonyl reactant: formaldehyde yields primary alcohols, other aldehydes yield secondary alcohols, and ketones yield tertiary alcohols.

Solution:

1. **Analyze the Product Structure:** The final synthesis product is 2-methylpropan-2-ol (tert-butanol):

$$(\mathrm{CH_3})_3\mathrm{C\text{-}OH}$$

This is a tertiary alcohol containing a central carbon atom bonded to three methyl ($-\mathrm{CH_3}$) groups and one hydroxyl ($-\mathrm{OH}$) group.

2. **Deconstruct the Grignard Reaction Addition:** The reaction introduces one methyl group from the methylmagnesium iodide ($\mathrm{CH_3MgI}$) reagent:

$$\text{Carbonyl Reactant} + \mathrm{CH_3MgI} \xrightarrow{\mathrm{H_3O^+}} (\mathrm{CH_3})_3\mathrm{C\text{-}OH}$$

Removing this incoming methyl group identifies the starting material as a symmetrical two-carbon ketone, which is acetone ($\mathrm{CH_3COCH_3}$).

Final Answer: $\boxed{\text{Acetone } (\mathrm{CH_3COCH_3})}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 19

Q20.

Solution

Concept: The Langmuir adsorption isotherm models monolayer gas adsorption on a finite number of distinct, equivalent surface sites. The equation relates the extent of adsorption (x/m) to the equilibrium pressure (P):

$$\frac{x}{m} = \frac{X_m KP}{1 + KP}$$

Solution:

1. **Analyze the High-Pressure Asymptote Phase (Region Y):** At high equilibrium pressures where $KP \gg 1$, the term 1 in the denominator becomes negligible. The equation simplifies to:

$$\frac{x}{m} \approx \frac{X_m KP}{KP} = X_m$$

2. **Identify the Governing Operational Assumption:** In this high-pressure limit, the adsorption extent reaches a constant maximum value (X_m), representing complete monolayer saturation of all available surface sites. Consequently, the rate of adsorption becomes zero-order with respect to gas pressure, and the curve forms a horizontal plateau.

Final Answer: $\boxed{\text{The rate of adsorption becomes zero-order with respect to gas pressure as all active surface sites reach complete saturation}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 20

Q21.

Solution

Concept: The electronic configuration of a transition metal ion governs the arrangement of electrons in its d-orbitals. According to Hund's rule, electrons occupy degenerate orbitals singly before pairing up. Total magnetic spin (S) is calculated from the number of unpaired electrons (n) as $S = n/2$.

Solution:

1. **Determine Unpaired Electrons for Mn^{2+}:** Manganese (Mn, $Z = 25$) has the ground-state electron configuration $[\mathrm{Ar}]3d^5 4s^2$. The Mn^{2+} ion loses the two $4s$ electrons:

$$\mathrm{Mn}^{2+} = [\mathrm{Ar}]3d^5$$

The five electrons occupy the five degenerate $3d$ orbitals singly ($\uparrow, \uparrow, \uparrow, \uparrow, \uparrow$), yielding 5 unpaired electrons.

2. **Determine Unpaired Electrons for Mn^{4+}:** The highly oxidized Mn^{4+} ion is formed by removing two additional electrons from the $3d$ subshell:

$$\mathrm{Mn}^{4+} = [\mathrm{Ar}]3d^3$$

These three electrons occupy three $3d$ orbitals singly ($\uparrow, \uparrow, \uparrow, \cdot, \cdot$), yielding 3 unpaired electrons.

3. **Calculate the Changes in Unpaired Electrons and Total Spin (S):** * Net change in unpaired electrons $= 5 - 3 = 2$ electrons (a decrease of 2). * Total magnetic spin value for Mn^{4+} $= S = \frac{3}{2}$.

Final Answer: $\boxed{\text{Decreases by 2 electrons; } S = 3/2}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 21

Q22.

Solution

Concept: The thermodynamic solubility of a sparingly soluble salt like gypsum ($CaSO_4 \cdot 2H_2O$) is influenced by the composition of the background solution. Solutes containing a common ion (Ca^{2+} or SO_4^{2-}) suppress dissolution via the common-ion effect. Conversely, introducing diverse (non-common) ions increases the ionic strength of the solution, which decreases the activity coefficients of the reacting ions and increases overall solubility (the diverse-ion or salt effect).

Solution:

1. **Evaluate the Background Solutions:** * 0.05 M $CaCl_2$: Contributes the common ion Ca^{2+}, decreasing gypsum solubility. * 0.05 M Na_2SO_4: Contributes the common ion SO_4^{2-}, decreasing gypsum solubility. * Pure distilled water: No common-ion suppression, but lacks diverse ions to enhance ionic strength. * 0.05 M NaCl: Composed entirely of diverse ions (Na^+ and Cl^-) that do not participate directly in the gypsum solubility product equilibrium.

2. **Determine the Highest Solubility Environment:** The 0.05 M NaCl solution increases the ionic strength of the solution matrix without introducing common-ion suppression, resulting in the highest thermodynamic solubility for gypsum.

Final Answer: $\boxed{\text{0.05 M NaCl}}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 22

Q23.

Solution

Concept: Acid-catalyzed esterification between a carboxylic acid and an alcohol follows a nucleophilic acyl substitution mechanism. Isotopic labeling experiments demonstrate that the oxygen atom forming the new ester linkage bridge originates exclusively from the alcohol reactant, while the hydroxyl group ($-$OH) of the carboxylic acid is eliminated as water.

Solution:

1. **Trace the Mechanistic Pathway:** During esterification, the carbonyl oxygen of the carboxylic acid (R-COOH) is protonated, and the alcohol molecule ($R' -^{18} OH$) attacks the acyl carbon center to form a tetrahedral intermediate.

2. **Identify the Position of the Label:** Proton transfer followed by the elimination of a water molecule removes the hydroxyl group originally belonging to the carboxylic acid backbone. The ^{18}O label remains attached to the alkyl group of the alcohol, positioning it exclusively within the ester linkage oxygen bridge (R-CO-^{18}O-R$'$).

Final Answer: $\boxed{\text{Exclusively within the ester linkage oxygen bridge (R-CO-}^{18}\text{O-R}')}$

$\boxed{\textbf{Answer: (A)}}$

Go Back to Question 23

Q24.

Solution

Concept: Covalent bonds are formed by the spatial overlap of atomic orbitals along or across an inter-nuclear axis. A collinear, head-on overlap of orbitals along the inter-nuclear axis forms a sigma (σ) bond, whereas a parallel, lateral overlap across the axis forms a pi (π) bond.

Solution:

1. **Analyze the Spatial Orientation in the Diagram:** The diagram illustrates two p-orbitals approaching each other along a dashed line designated as the inter-nuclear axis. The lobes point directly toward one another along this axis.
2. **Evaluate the Wave Function Phases and Bond Type:** The overlapping lobes have identical signs ($+$ overlapping with $+$, and $-$ overlapping with $-$), denoting an in-phase interaction. This head-on, collinear alignment along the inter-nuclear axis results in constructive interference, forming a bonding sigma (σ) covalent orbital.

Final Answer: $\boxed{\text{Bonding } \sigma \text{ covalent orbital formation arising from collinear head-on } p\text{-}p \text{ overlap}}$

$\boxed{\textbf{Answer: (B)}}$

Go Back to Question 24

Q25.

Solution

Concept: The Walkley-Black method quantifies soil organic carbon through a wet oxidation reaction with a known excess of potassium dichromate ($K_2Cr_2O_7$) under acidic conditions. The unreacted dichromate is determined by back-titration with standard ferrous ammonium sulfate (FAS). The difference in titrant volume between the blank and the sample is proportional to the mass of oxidizable organic carbon.

Solution:

1. **Calculate the Volume Difference (ΔV) of Titrant:**

$$\Delta V = V_{\text{blank}} - V_{\text{sample}} = 24.0 \text{ mL} - 14.0 \text{ mL} = 10.0 \text{ mL}$$

2. **Determine the Milliequivalents of Carbon Oxidized:**

$$\text{meq of FAS} = \Delta V \times N_{\text{FAS}} = 10.0 \text{ mL} \times 0.500 \text{ N} = 5.0 \text{ meq}$$

Since the milliequivalents of FAS consumed match the milliequivalents of dichromate reduced by the organic carbon, the sample contained 5.0 meq of oxidizable carbon.

3. **Calculate the Mass of Oxidizable Organic Carbon:** Carbon undergoes a 4-electron valence change during oxidation ($C^0 \to C^{4+} + 4e^-$). The milliequivalent weight of carbon is:

$$\text{eq weight of C} = \frac{12.0 \text{ g/mol}}{4} = 3.0 \text{ g/eq} = 3.0 \text{ mg/meq}$$

$$\text{Mass of Organic Carbon} = 5.0 \text{ meq} \times 3.0 \text{ mg/meq} = 15.0 \text{ mg}$$

Final Answer: $\boxed{15.0 \text{ mg}}$

Answer: (A)

Go Back to Question 25

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	B	3	A	4	B	5	A
6	A	7	A	8	A	9	A	10	A
11	A	12	B	13	A	14	A	15	A
16	A	17	A	18	A	19	A	20	A
21	A	22	A	23	A	24	B	25	A