

TEST 1

- How does a S^{2-} ion differ from an electrically neutral sulfur atom?
A) from number of electrons
B) from its atomic number
C) from its nuclear charge
D) from its mass number
- Which row contains only substances with polar covalent bonds?
A) HCl, NaCl, Cl₂
B) O₂, H₂O, CO₂
C) H₂O, NH₃, CCl₄
D) NaBr, NaCl, Cl₂
- Which of the following type bond explains the relatively high boiling temperature of the water?
A) hydrogen
B) ionic
C) coordinate
D) covalent polar
- Reactions occurring at high rate at a temperature of 25°C are characterized by:
A) low activating energy
B) high activating energy
C) high heat of reaction
D) small heat of reaction
- What change in the reaction system $2NOBr_{(gas)} \rightleftharpoons 2NO_{(gas)} + Br_{2(gas)}$ will shift the equilibrium forward?
A) increase in pressure
B) decrease in concentration of NOBr
C) decrease in pressure
D) increase in concentration of bromine
- An equilibrium has been established in the system $NaCl_{(solid)} \rightleftharpoons NaCl_{(aq)}$. $NaCl_{(aq)}$ refers to a solution that is:
A) diluted
B) concentrated
C) unsaturated
D) saturated
- What is the molarity of a solution containing 0.10 moles of nitric acid in 250 mL?
A) 0.025 mol/L
B) 0.10 mol/L
C) 0.4 mol/L
D) 0.25 mol/L
- Which of the following diluted solutions will have a boiling temperature closest to 100 °C?
A) 0.10 mol/L CH₃COONa
B) 0.10 mol/L Na₂SO₄
C) 0.10 mol/L AlCl₃
D) 0.10 mol/L K₃PO₄
- What is the correct term for the phase change from solid directly to gas?
A) vaporization
B) sublimation
C) fusion
D) deposition
- What is the hydroxide concentration for a solution with a pH of 10 at 25 °C?
A) 10⁻¹⁴ mol/L
B) 10⁻¹⁰ mol/L
C) 10⁻⁴ mol/L
D) 10⁻¹ mol/L
- Find the wrong name:
A) N₂O – dinitrogen oxide
B) KNO₂ – potassium nitrate
C) Pb(NO₃)₂ – lead dinitrate
D) Na₂CO₃ – disodium carbonate
- If an aqueous solution of a salt has a pH of 9, then it is a salt of:
A) strong acid and strong base
B) weak acid and weak base
C) strong acid and weak base
D) weak acid and strong base

13. Which of the following substances is a neutralization product of a strong acid with a strong base?

- A) AlCl_3 B) KNO_3 C) BaCO_3 D) $\text{Fe}_2(\text{SO}_4)_3$

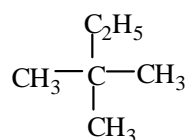
14. Which of these reactions **is not** an oxidation-reduction process?

- A) $\text{Cu} + 2 \text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + \text{SO}_2 + 2 \text{H}_2\text{O}$
 B) $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
 C) $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 D) $\text{Mg} + \text{ZnSO}_4 \rightarrow \text{Zn} + \text{MgSO}_4$

15. In the reaction: $\text{Fe}_2\text{O}_3 + 3 \text{CO} \rightarrow 2 \text{Fe} + 3 \text{CO}_2$ carbon atom is:

- A) oxidant and reduces B) reductant and reduces
 C) oxidant and oxidizes D) reductant and oxidizes

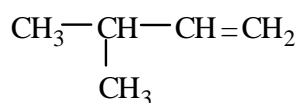
16. The structural formula



corresponds to:

- A) 2,2-dimethylbutane B) hexane
 C) 2,2-diethylpentane D) 2-ethyl-2-methylpropane

17. Which statement about the compounds



$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH} = \text{CH}_2$ and **is false?**

- A) they are chain isomers
 B) they are positional isomers
 C) they have one and the same molecular formula
 D) they are alkenes

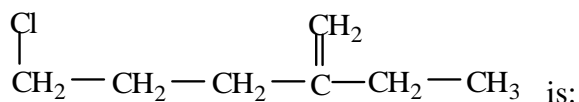
18. The addition product of HBr and 2-methyl-2-butene is:

- A) 1-bromo-2-methylbutane B) 2-bromo-2-methylbutane
 C) 3-bromo-2-methylbutane D) 1-bromo-3-methylbutane

19. An organic compound has a molecular formula of C_3H_4 . Which compound below belongs to the same class of hydrocarbons?

- A) C_2H_6 B) C_3H_6 C) C_4H_8 D) C_5H_8

20. The correct name of the compound



- A) 6-chloro-3-methylenehexane
 B) 5-chloro-2-ethyl-1-pentene
 C) 2-ethyl-5-chloro-1-pentene
 D) 1-chloro-4-methylenehexane

21. Which organic structure is methyl propyl ether (methoxypropane)?
 A) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-O-C}_3\text{H}_7$ B) $\text{C}_2\text{H}_5\text{OCH}_3$
 C) $\text{CH}_3\text{-O-C}_3\text{H}_7$ D) $\begin{array}{c} \text{CH}_3\text{-CH-CH}_2\text{-OH} \\ | \\ \text{CH}_3 \end{array}$
22. Sodium phenoxide is the product of the reaction:
 A) $\text{C}_6\text{H}_5\text{OH} + \text{NaOH} \rightarrow$ B) $\text{C}_6\text{H}_5\text{CH}_2\text{OH} + \text{Na} \rightarrow$
 C) $\text{C}_6\text{H}_5\text{Cl} + \text{Na} \rightarrow$ D) $\text{C}_6\text{H}_5\text{Cl} + \text{NaOH} \rightarrow$
23. Acetone can be obtained by oxidation of:
 A) ethanal B) propanal C) 1-propanol D) 2-propanol
24. An ester can be prepared by the reaction of:
 A) an alcohol and an organic acid B) an alcohol and an aldehyde
 C) two alcohols D) an acid and a ketone
25. The product of benzoic acid chlorination in the presence of FeCl_3 is:
 A) 2-chlorobenzoic acid B) 3-chlorobenzoic acid
 C) 4-chlorobenzoic acid D) 2,4,6-trichlorobenzoic acid
26. Which hydroxy acid has enantiomers?
 A) 2-hydroxybutanoic acid B) 3-hydroxy-3-methylbutanoic acid
 C) 4-hydroxybutanoic acid D) 2-ethyl-2-hydroxybutanoic acid
27. Deoxyribose in DNA nucleotides belongs to this family of biologically important molecules:
 A) nucleic acids B) proteins
 C) carbohydrates D) lipids
28. Which reaction can be used to obtain aniline?
 A) $\text{C}_6\text{H}_5\text{OH} + \text{NH}_3 \rightarrow$
 B) $\text{C}_6\text{H}_5\text{NH}_2 + \text{Br}_2 \rightarrow$
 C) $\text{C}_6\text{H}_5\text{Cl} + \text{NH}_3 \rightarrow$
 D) $\text{C}_6\text{H}_5\text{NO}_2 + \text{H}_2 \rightarrow$
29. The amino acids are derivatives of:
 A) carboxylic acids B) aldehydes
 C) alcohols D) hydrocarbons
30. Peptide bond is the bond between:
 A) alcohols and amino acids B) α -amino acids
 C) carboxylic acids and amines D) amines and carbohydrates

TEST 2

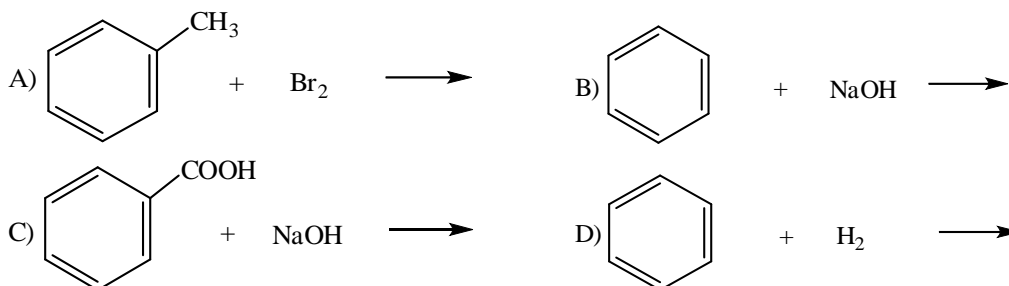
1. The mass number and atomic number of the fluorine atom are shown by the symbol ${}_{9}^{19}\text{F}$. Therefore, the number of electrons of the fluorine ion in sodium fluoride is:
A) 9 B) 20 C) 19 D) 10
2. A neutral atom, atomic number 35 and atomic mass 80, contains:
A) 80 electrons B) 80 neutrons C) 35 protons D) 45 electrons
3. The element **Ba** an basic oxide. The bonds in this oxide are:
A) covalent non-polar B) covalent polar
C) ionic D) both, ionic and covalent
4. Which compound contains no ionic character?
A) NaOH B) SO_3 C) CaO D) Na_2SO_4
5. The Rate Law for the reaction $\text{A}_{(\text{solid})} + 2\text{B}_{(\text{aq})} \rightarrow \text{D}_{(\text{solid})}$ is:
A) $V = k \cdot [\text{A}] \cdot [\text{B}]^2$ B) $V = k + [\text{A}] + [\text{B}]^2$
C) $V = k \cdot [\text{A}] \cdot [\text{B}]$ D) $V = k \cdot [\text{B}]^2$
6. The equilibrium $\text{CO}_{(\text{gas})} + 2 \text{H}_2_{(\text{gas})} \rightleftharpoons \text{CH}_3\text{OH}_{(\text{gas})}$ has been established in a container. In order to increase the amount of methanol, the following is required:
A) increase in the pressure within the container
B) reduction in the pressure within the container
C) reduction in hydrogen concentration
D) reduction in carbon oxide concentration
7. The reaction $\text{CH}_3\text{CH}_2\text{C} \equiv \text{CH} + 2\text{H}_2 \xrightarrow{\text{Ni}} \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ is an example of:
A) homogeneous catalysis B) heterogeneous catalysis
C) autocatalysis D) activation of catalyst
8. Physiological saline solution is 0.9 % solution of NaCl. How many grams of NaCl and how many grams of water are needed in order to prepare 200 g physiological saline solution?
A) 1.8 g NaCl and 200 g water B) 1.8 g NaCl and 198.2 g water
C) 18 g NaCl and 182 g water D) 18 g NaCl and 200 g water
9. Which compound in the reaction $\text{NH}_3_{(\text{aq})} + \text{H}_2\text{O}_{(\text{aq})} \rightarrow \text{NH}_4^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})}$ is behaving as an acid?
A) water B) ammonium hydroxide
C) none of them D) ammonia
10. The water solution of which compound has the lowest pH?
A) NaHCO_3 B) H_2S C) HBr D) HCN
11. Which of the following statements about copper is correct?
A) copper dissolves in diluted acids and forms salts
B) copper has a high melting point due to the strong covalent bonds
C) copper is an alloy
D) copper conducts electricity because the electrons are free to move

12. Which of the oxides does not react with CaO?
 A) Na₂O B) SO₂ C) SO₃ D) CO₂
13. In the reaction $I_2 + 10 HNO_3 \rightarrow 2 HIO_3 + 10 NO_2 + 4 H_2O$ iodine is:
 A) an oxidant and reduces nitrogen
 B) an oxidant and oxidizes nitrogen
 C) a reductant and oxidizes nitrogen
 D) a reductant and reduces nitrogen
14. Of the compounds below, in which one does nitrogen have the lowest oxidation number?
 A) NH₄Cl B) N₂O C) HNO₂ D) HNO₃
15. Aqueous HCl has been added to substance **X** and produces salt and water. Most likely the substance **X** is:
 A) Mg B) Ca(OH)₂ C) NaF D) Na₂SO₄
16. Which of the compounds below is not an isomer to the other three?
 A) CH₃CH₂CH₂CH₂OH B) CH₃CH₂COOCH₃
 C) CH₃CH₂CH₂COOH D) CH₃COOCH₂CH₃
17. Why do the substances shown below all belong to the same homologous series?
 CH₂ = CH₂ CH₃CH = CHCH₃ CH₃CH₂CH = CHCH₂CH₃
 A) they all contain an even number of carbon atoms
 B) they are all saturated
 C) they are all hydrocarbons
 D) they all contain the same functional group
18. Ethene CH₂=CH₂ is an unsaturated hydrocarbon. Which description of the bonding in ethene is correct?
 A) all atoms in the molecule have a share of eight electrons
 B) each carbon atom shares two of its electrons with hydrogen atoms and two of its electrons with a carbon atom
 C) each carbon atom shares two of its electrons with hydrogen atoms and one of its electrons with a carbon atom
 D) the two carbon atoms share a total of six electrons with other atoms
19. An organic substance **Y** reacts with Na but does not react with NaOH. Which type of substance is **Y**?
 A) an alcohol B) a phenol C) an aldehyde D) a ketone
20. Which reaction does not take place in the dark?
 A) CH₄ + 2O₂ → CO₂ + 2H₂O B) C₂H₄ + H₂ → C₂H₆
 C) C₂H₄ + H₂O → C₂H₅OH D) CH₄ + Cl₂ → CH₃Cl + HCl
21. Esters are made by reacting an alcohol with a carboxylic acid. Which acid and alcohol react together to form the following ester HCOOCH₂CH₂CH₃?
 A) propanoic acid and methanol B) propanoic acid and ethanol
 C) methanoic acid and ethanol D) methanoic acid and propanol

22. The formula C_6H_5CN represents:

- A) benzonitrile B) benzenamine C) benzamide D) nitrobenzene

23. Which chemical reaction is impossible?



24. Tollens's reagent (solution of $AgNO_3$ and NH_3) is used to identify glucose. In this reaction, the glucose acts as a reductant because its molecule contains:

- A) carboxylic group B) hydroxyl group
C) aldehyde group D) six carbon atoms

25. From the reactions below select one that represents an addition reaction:

- A) $CH_3CH=CH_2 + HCl \rightarrow CH_3CHClCH_3$
B) $CH_3CH_2CH_3 + Cl_2 \rightarrow CH_3CHClCH_3$
B) $CH_3CHClCH_3 + KOH \rightarrow CH_3CH=CH_2 + KCl + H_2O$
Γ) $CH_3CHClCH_3 + H_2O \rightarrow CH_3CH(OH)CH_3 + HCl$

26. Glucose is classified as a:

- A) aldopentose B) ketopentose C) aldohexose D) ketohexose

27. The reagent that can be used to distinguish between pentanal and pentanone is:

- A) HCl B) $Cu(OH)_2$ C) $FeCl_3$ D) $Br_2(aq)$

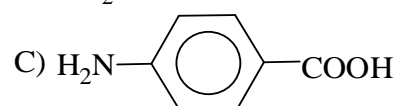
28. An aqueous solution of the organic compound dimethylamine has a $pH > 7$. Which statement about dimethylamine is correct?

- A) it neutralizes an aqueous solution of sodium hydroxide
B) it reacts with copper (II) carbonate to give carbon dioxide
C) it reacts with hydrochloric acid to form a salt
D) it turns blue litmus red

29. Natural polymers are:

- A) teflon and polyacrylonitrile B) cellulose and proteins
C) nylon and polyvinyl chloride D) polyethylene and polystyrene

30. Which structure presents an amino acid that is a building unit of proteins?

- A) $CH_2CH_2CH_2COOH$
|
 NH_2
- B) $CH_3CHCOOH$
|
 NH_2
- C)  $H_2N-C_6H_4-COOH$
- D) $CH_2CH_2CHCOOH$
| |
 NH_2 NH_2

TEST 3

1. The electrons located on different electron shells have different:
A) life-span B) charge C) mass D) energy
2. The mass number and atomic number of the calcium atom are shown by the symbol ${}^{40}_{20}\text{Ca}$. Therefore, the number of electrons of the calcium ion in calcium dichloride is:
A) **18** B) **20** C) **22** D) **60**
3. What type of bonds are formed in the product of the reaction $2\text{K} + \text{H}_2 \rightarrow 2\text{KH}$?
A) hydrogen bonds B) ionic
C) covalent polar D) covalent non-polar
4. Which of the following compounds does not have covalent bonding?
A) N_2O_5 B) SO_3 C) CaO D) CO_2
5. With the time, the rate of the reaction $2\text{H}_2\text{O}_2 \xrightarrow{\text{cat, t}^\circ} 2\text{H}_2\text{O} + \text{O}_2$ decreases because:
A) temperature increases
B) concentration of hydrogen peroxide decreases
C) oxygen concentration increases
D) concentration of catalyst increases
6. The chemical reaction $\text{CO}_2(\text{gas}) + 2\text{C}(\text{solid}) \rightleftharpoons 2\text{CO}(\text{gas})$ is already at equilibrium. The yield of CO can be increased if:
A) the pressure in reaction container is decreased
B) the pressure in reaction container is increased
C) the amount of C is increased
D) the concentration of carbon dioxide is decreased
7. The reaction $\text{SO}_2 + \text{O}_2 \xrightarrow{\text{NO}} \text{SO}_3$ is an example of:
A) homogenous catalysis B) heterogeneous catalysis
C) autocatalysis D) activation of catalyst
8. Henry's law about solubility of gases in liquids does not apply to solubility of:
A) O_2 B) N_2 C) CO_2 D) CH_4
9. Water solution of a compound turns the litmus color to red. The compound is:
A) Na_2SO_4 B) NaHCO_3 C) $(\text{NH}_4)_2\text{SO}_4$ D) KCN
10. Which pH value characterizes the solution with the lowest concentration of H^+ ?
A) 1 B) 5 C) 10 D) 14
11. Which of these compounds do not react with each other?
A) Na_2O and $\text{Ca}(\text{OH})_2$ B) Ag_2O and HNO_3
C) CO_2 and $\text{Ba}(\text{OH})_2$ D) SO_2 and NaOH

12. Sulfuric acid can be obtained by:

- A) dissolving SO_2 in water
 B) dissolving SO_3 in water
 C) reaction between SO_2 and H_2
 D) reaction between SO_3 and H_2

13. In the reaction $2\text{Fe} + 3\text{V}_2\text{O}_3 \rightarrow \text{Fe}_2\text{O}_3 + 6\text{VO}$ iron atom is:

- A) oxidant and reduces vanadium
 B) oxidant and oxidizes vanadium
 C) reductant and oxidizes vanadium
 D) reductant and reduces vanadium

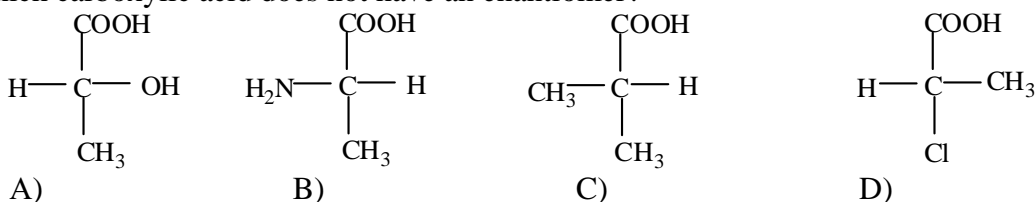
14. The oxidation number of sulfur is the lowest in:

- A) Na_2S B) SO_3 C) H_2SO_3 D) SO_2

15. Diluted solution of HCl has been added to compound **X**; the products of the reaction are salt and hydrogen. Most likely the compound **X** is:

- A) Mg B) $\text{Ca}(\text{OH})_2$ C) NaHCO_3 D) Na_2S

16. Which carboxylic acid does not have an enantiomer?



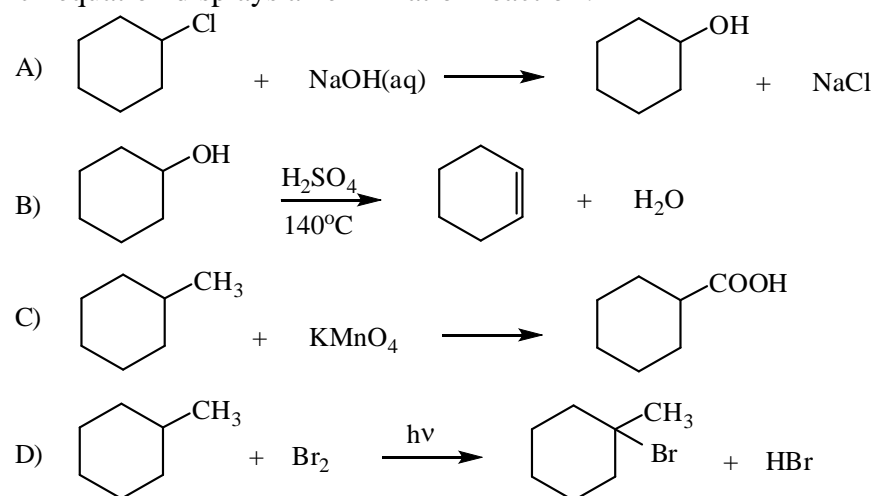
17. Alkenes react with HCl because:

- A) all of them contain carbon and hydrogen atoms
 B) all of them are saturated
 C) all of them are hydrocarbons
 D) all of them participate in addition reactions

18. The molecule of ethene $\text{CH}_2=\text{CH}_2$ has:

- A) one σ -bond and four π -bonds B) four σ -bonds and one π -bond
 C) five σ -bonds and one π -bond D) two σ -bonds and three π -bonds

19. Which equation displays an elimination reaction?



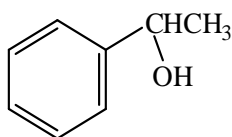
20. What is the product of intramolecular dehydration of ethanol?
 A) CH_3CH_3 B) $\text{CH}_2=\text{CH}_2$ C) $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ D) CH_3OCH_3
21. The glycerol is:
 A) monosaccharide B) tertiary alcohol C) diol D) triol
22. Water solution of phenol has:
 A) $\text{pH} < 7$ B) $\text{pH} = 7$ C) $\text{pH} > 7$ D) $\text{pH} = 0$
23. Which of the structures below belongs to an ester?
 A) $\text{HCOCH}_2\text{CH}_3$
 $\begin{array}{c} \text{H} \\ \parallel \\ \text{O} \end{array}$
 B) $\text{CH}_3\text{CNHCH}_3$
 $\begin{array}{c} \text{O} \\ \parallel \\ \text{C} \end{array}$
 C) $\text{HCCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
 $\begin{array}{c} \text{H} \\ \parallel \\ \text{O} \end{array}$
 D) $\text{CH}_3\text{CH}_2\text{CCH}_2\text{CH}_3$
 $\begin{array}{c} \text{O} \\ \parallel \\ \text{C} \end{array}$
24. Substitution reaction between chlorine and butanoic acid in the presence of catalyst produces:
 A) 3-chlorobutanoic acid B) 4-chlorobutanoic acid
 C) 2-chlorobutanoic acid D) 1-chlorobutane
25. Which equation presents hydrolysis of an ester?
 A) $\text{CH}_3\text{OH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{OOCCH}_3 + \text{H}_2\text{O}$
 B) $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_3 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
 C) $\text{C}_{17}\text{H}_{35}\text{COOH} + \text{NaOH} \rightarrow \text{C}_{17}\text{H}_{35}\text{COONa} + \text{H}_2\text{O}$
 D) none of them
26. Which statement about glucose is **false**?
 A) it is a natural monosaccharide
 B) it dissolves in water
 C) it contains keto group
 D) it contains 5 hydroxyl groups
27. Which reagent can be used to distinguish between butanone and butanal?
 A) HCl B) FeCl_3
 C) $\text{Cu}(\text{OH})_2$ D) Br_2 (water solution)
28. Which amine cannot form a salt with acetic acid?
 A) $\text{CH}_3\text{-NH}_2$ B) $\text{C}_6\text{H}_5\text{NH}_2$ C) $\text{CH}_3\text{-NH-C}_2\text{H}_5$ D) $(\text{CH}_3)_3\text{N}$
29. Peptide bond is formed in the reaction between:
 A) two amino acids B) two hydroxy acids
 C) two carboxylic acids D) two reducing sugars
30. Total hydrolysis of cellulose produces:
 A) glucose B) cellobiose
 C) fructose D) glucose and fructose

TEST 4

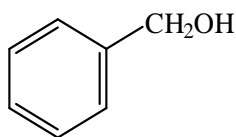
1. Mass number of an element, which has 24 electrons and 28 neutrons is:
A) 24 B) 28 C) 52 D) 48
2. What statement **is false**?
A) nucleus does not have charge B) protons have positive charge
C) neutrons do not have charge D) electrons have negative charge
3. Which row contains only atoms of metals?
A) Fe, Na, I B) S, Cu, Ni C) Li, Al, Ba D) Br, K, Cr
4. What types of bonds are formed between the nitrogen and hydrogen atoms in the ammonia molecule?
A) covalent polar B) covalent non-polar
C) ionic D) hydrogen
5. Which of the following is true for a chemical reaction at equilibrium?
A) the rate constants for the forward and reverse reactions are equal
B) both the forward and reverse reactions stop
C) the concentrations of reactants and products are equal
D) the rates of the forward and reverse reactions are equal
6. Which action will drive the reaction $4 \text{HCl (g)} + \text{O}_2 \text{(g)} \rightleftharpoons 2 \text{H}_2\text{O (g)} + 2 \text{Cl}_2 \text{(g)}$ to the right?
A) heating the equilibrium mixture B) adding water to the system
C) decreasing the oxygen concentration D) increasing the system's pressure
7. What is the correct statement about the process of dissolution?
A) it is a reversible process
B) it depends on the temperature
C) it depends on the nature of solvent and solute
D) all statements are correct
8. Which of the following equimolar solutions has osmotic pressure that is 3 times higher than the osmotic pressure of glucose solution with the same concentration?
A) CuSO_4 B) Na_2SO_4 C) FeCl_3 D) CH_3COOH
9. Of the compounds below, in which one does hydrogen have the lowest oxidation number?
A) NH_3 B) H_2 C) NaH D) HCl
10. To 0.1 mol/L NaOH is added equal volume of 0.1 mol/L HCl. Most likely the pH of the solution obtained is:
A) 0 B) = 7 C) > 7 D) < 7
11. If the solutions of NaCl and Na_2SO_4 are isotonic, they have:
A) one and the same molar concentration B) one and the same osmotic pressure
C) one and the same density D) one and the same mass
12. Which dissociation process **is not** presented correctly?

- A) $\text{NaHCO}_3 \rightarrow \text{Na}^+ + \text{H}^+ + \text{CO}_3^{2-}$
 B) $\text{NH}_4\text{NO}_3 \rightarrow \text{NH}_4^+ + \text{NO}_3^-$
 C) $\text{KNO}_2 \rightarrow \text{K}^+ + \text{NO}_2^-$
 D) $\text{Ba}(\text{OH})_2 \rightarrow \text{Ba}^{2+} + 2 \text{OH}^-$

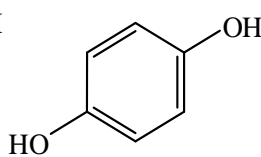
13. Which of the salts below has water solution with $\text{pH} > 7$?
 A) NaF B) NaClO_4 C) NaHSO_4 D) Na_2CO_3
14. Which of the reactions below represents an oxidation-reduction reaction?
 A) $\text{Zn} + 2 \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
 B) $\text{ZnCl}_2 + 2 \text{NaOH} \rightarrow \text{Zn}(\text{OH})_2 + 2 \text{NaCl}$
 C) $\text{ZnCl}_2 \rightarrow \text{Zn}^{2+} + 2 \text{Cl}^-$
 D) $\text{Zn}(\text{OH})_2 + 2 \text{HCl} \rightarrow \text{ZnCl}_2 + 2 \text{H}_2\text{O}$
15. In the reaction $2 \text{ZnS} + 3 \text{O}_2 \rightarrow 2 \text{ZnO} + 2 \text{SO}_2$ sulfur atom is:
 A) a reducing agent and reduces B) a reducing agent and oxidizes
 C) an oxidizing agent and oxidizes D) an oxidizing agent and reduces
16. Which formula represents an arene?
 A) C_7H_{12} B) C_7H_8 C) C_7H_{14} D) C_7H_{16}
17. Which row contains compounds that are isomers to each other?
 A) benzene, methylbenzene, ethylbenzene
 B) 2-methyl-1-butene, 2-pentene, 2-methyl-2-butene
 C) cyclopentane, pentene, 2,2-dimethylbutane
 D) methane, ethane, propane
18. Free-radical halogenation proceeds under application of:
 A) Ni B) FeCl_3
 C) concentrated H_2SO_4 D) UV irradiation
19. The product of 1-butyne hydration in the presence of $\text{HgSO}_4/\text{H}_2\text{SO}_4$ is:
 A) butanone B) 2-butanol
 C) 1,2-butanediol D) butanal
20. Which structure belongs to a secondary alcohol?



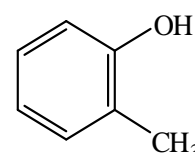
A)



B)



C)



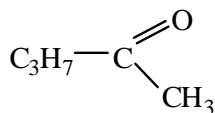
D)

21. The organic acid that can be made from ethanol is:
 A) $\text{C}_3\text{H}_7\text{OH}$ B) formic acid
 C) acetic acid D) butanoic acid
22. Which reaction is common for the ethanol, glycerol and phenol?
 A) electrolytic dissociation B) reaction with NaOH
 C) reaction with $\text{Cu}(\text{OH})_2$ D) reaction with Na

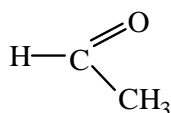
23. Which chemical reaction cannot take place?

- A) $C_6H_5COOH + CH_3OH \rightarrow C_6H_5COOCH_3 + H_2O$
 B) $CH_3COOH + HCl \rightarrow CH_3COCl + H_2O$
 C) $HCOOH + CH_3NH_2 \rightarrow HCONHCH_3 + H_2O$
 D) $CH_3COCl + NH_3 \rightarrow CH_3CONH_2 + HCl$

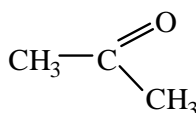
24. Which structure presents an aldehyde?



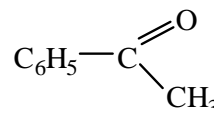
A)



B)



C)



D)

25. The product of benzoic acid nitration is:

- A) o-nitrobenzoic acid
 B) p-nitrobenzoic acid
 C) m-nitrobenzoic acid
 C) both, o- and p-benzoic acid

26. Which of the following esterification processes is not properly expressed?

- A) $C_2H_5COOH + CH_3OH \rightleftharpoons C_2H_5COOCH_3 + H_2O$
 B) $CH_3COOH + C_2H_5OH \rightleftharpoons C_2H_5COOCH_3 + H_2O$
 C) $C_6H_5COOH + C_2H_5OH \rightleftharpoons C_6H_5COOC_2H_5 + H_2O$
 D) $C_2H_5COOH + C_4H_9OH \rightleftharpoons C_2H_5COOC_4H_9 + H_2O$

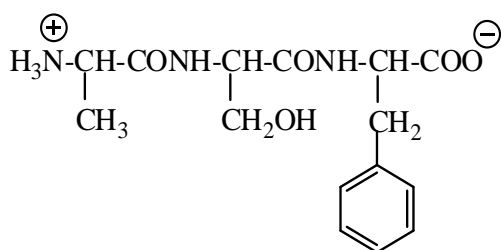
27. Which carbohydrate cannot be hydrolyzed?

- A) starch
 B) sucrose
 C) cellulose
 D) fructose

28. Which organic substance is a secondary amine?

- A) $CH_3-CH_2-CONH_2$
 B) $CH_3CH_2NHCH_2CH_3$
 C) $C_3H_7NH_2$
 D) $C_6H_5NH_2$

29. The structure below presents:



- A) α -amino acid
 B) ω -amino acid
 C) dipeptide
 D) tripeptide

30. Which name does not belong to amino acid?

- A) aniline
 B) alanine
 C) phenylalanine
 D) valine

TEST 5

1. The number of electrons and neutrons of an element is 18 and 20 respectively. Its mass number is:

- A) 22 B) 20 C) 38 D) 2

2. Which bond has the least ionic character?

- A) H – F B) Li – F C) Li – Br D) F – F

3. The most electronegative element among the following is

- A) sodium B) bromine C) fluorine D) oxygen

4. The maximum number of covalent bonds formed by nitrogen is

- A) 5 B) 2 C) 3 D) 4

5. The aqueous solution of glycerol:

- A) boils at the same temperature as that of water
B) boils at a lower temperature than that of water
C) freezes at a lower temperature than that of water
D) freezes at a higher temperature than that of water

6. The metal that does not give H₂ on treatment with dilute HCl is

- A) Zn B) Fe C) Ag D) Ca

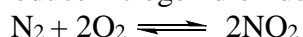
7. The Rate Law expresses the rate of a reaction in terms of the concentrations of the:

- A) reactants B) products C) by-products D) catalysts

8. Which of the following is the weakest acid?

- A) hydrochloric acid B) carbonic acid
C) sulfuric acid D) nitric acid

9. Nitrogen reacts with oxygen to produce nitrogen dioxide.



The reaction is reversible and endothermic. The conditions that lead to the largest yield of nitrogen dioxide are:

- A) high temperature and high pressure
B) low temperature and low pressure
C) high temperature and low pressure
D) low temperature and high pressure

10. CaSO₄ is called:

- A) calcium sulfide B) calcium sulfate
C) calcium sulfite D) calcium sulfoxide

11. When water and an active metal react, what are the two products that result?

- A) hydrogen and hydroxide B) oxygen and hydroxide
C) oxide and base D) hydroxide and acid

12. Under similar conditions, which of the following is the best reducing agent?

- A) fluoride ion B) chloride ion C) bromide ion D) iodide ion

13. Three liters of sodium chloride (NaCl) solution contain 6 moles of the solute. What is the molarity of solution?

- A) 5 molar B) 2 molar C) 2.5 molar D) 12.5 molar

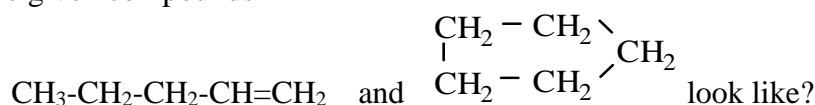
14. Which of the following **is not** a strong base?

- A) KOH B) Ba(OH)₂ C) Al(OH)₃ D) LiOH

15. In the reaction $\text{Ag} + 2\text{HNO}_3 (\text{conc.}) \rightarrow \text{AgNO}_3 + \text{NO}_2 + \text{H}_2\text{O}$ silver metal is:

- A) a reducing agent and oxidizes
 B) a reducing agent and reduces
 C) an oxidizing agent and oxidizes
 D) an oxidizing agent and reduces

16. What do the given compounds



- A) are of the same homologous series
 B) have the same properties
 C) have the same molecular formula
 D) have the same boiling point

17. What is the name given to the non-superimposable mirror image forms of chiral compounds?

- A) cis-trans B) enantiomers C) anomers D) diastereomers

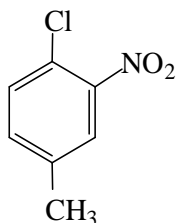
18. The triple bond between the carbon atoms causes acetylene, C₂H₂, to have which of the following shapes?

- A) trigonal planar B) linear
 C) tetrahedral D) trigonal bipyramidal

19. The isomerism that exists between CH₃CHCl₂ and CH₂ClCH₂Cl is

- A) chain isomerism B) functional group isomerism
 C) positional isomerism D) metamerism

20. The correct IUPAC name for the compound is

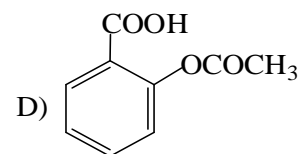
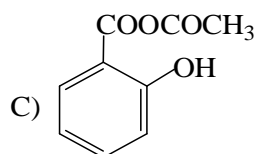
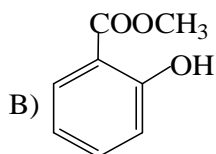
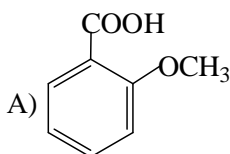


- A) 1-chloro-2-nitro-4-methylbenzene
 B) 1-chloro-4-methyl-2-nitrobenzene
 C) 2-chloro-1-nitro-5-methylbenzene
 D) m-nitro-p-chlorotoluene

21. The organic reaction represented by equation $\text{CH}_3\text{-CH=O} + \text{H}_2 \rightarrow \text{CH}_3\text{-CH}_2\text{-OH}$ is an example of:

- A) addition reaction B) condensation reaction
 C) oxidation reaction D) elimination reaction

22. The formula $C_6H_5-CO-CH_3$ represents:
 A) acetone B) acetic acid C) acetophenone D) phenyl acetate
23. Monosaccharide fructose is classified as an:
 A) aldohexose B) ketohexose C) aldopentose D) ketopentose
24. Which of the following compounds is primary aliphatic amine?
 A) $C_6H_5-NH-C_2H_5$ B) $C_2H_5-NH_2$
 C) $(CH_3)_2NH$ D) $C_6H_5-NH_2$
25. The alkaline hydrolysis of fats and oils produces
 A) alcohol and ester B) propane-1,1,2-triol and fatty acids
 C) glycerol and fatty acids D) glycerol and soap
26. The synthesis of aspirin is classified as an esterification reaction in which salicylic acid is treated with acetic anhydride. Which of the following formulas represent the structure of aspirin?



27. pH value of a water solution of CH_3NH_2 is
 A) 7 B) < 7 C) > 7 D) 0
28. Which of the following equations represents a reaction of esterification?
 A) $CH_3CH_2CH_3 + Br_2 \rightarrow CH_3CH_2CH_2Br + HBr$
 B) $CH_3CH = CH_2 + HBr \rightarrow CH_3-CH_2-CH_2Br$
 C) $CH_3CH_2COOH + NaOH \rightarrow CH_3CH_2COONa + H_2O$
 D) $CH_3COCl + CH_3CH_2OH \rightarrow CH_3COOCH_2CH_3 + HCl$
29. Which of the following represents lysine at a pH = 1
 A) $H_2N(CH_2)_4\underset{\substack{| \\ NH_2}}{CH}COOH$ B) $H_2N(CH_2)_4\underset{\substack{| \\ NH_3^+}}{CH}COO^-$
 C) $H_3^+N(CH_2)_4\underset{\substack{| \\ NH_3^+}}{CH}COOH$ D) $H_3^+N(CH_2)_4\underset{\substack{| \\ NH_2}}{CH}COO^-$
30. What is the name of the bond that joins amino acids together in a protein?
 A) peptide B) ether C) ester D) glycoside

TEST 6

1. The mass number and atomic number of the lithium atom are shown by the symbol ${}^7_3\text{Li}$. What is the correct symbol for the lithium ion in lithium chloride?

- A) ${}^6\text{Li}^-$ B) ${}^6\text{Li}^+$ C) ${}^7_3\text{Li}^+$ D) ${}^7_3\text{Li}^-$

2. In period 3 of the periodic table the atom with the largest atomic radius is located in group:

- A) 1 B) 3 C) 5 D) 7

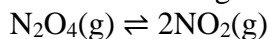
3. Which molecule is a polar molecule?

- A) N_2 B) CH_4 C) CO_2 D) H_2O

4. Which substance has a polar covalent bond between its atoms?

- A) NaH B) NaCl C) F_2 D) NH_3

5. Dinitrogen tetroxide, N_2O_4 , breaks down into nitrogen dioxide, NO_2 .



The reaction is reversible and endothermic. Which conditions will give the largest yield of nitrogen dioxide?

- A) high temperature and high pressure B) low temperature and low pressure
C) high temperature and low pressure D) low temperature and high pressure

6. All of the factors listed below increase the rate of reaction $\text{CH}_3\text{COOH} + \text{CH}_3\text{OH} \rightarrow$ except:

- A) increase in pressure B) adding of catalyst
C) increase in temperature D) increase in methanol concentration

7. Which of the following dilute solutions has the lowest pH?

- A) 0.010 mol/L HCl B) 0.010 mol/L NaOH
C) 0.010 mol/L CH_3COOH D) 0.010 mol/L NH_4OH

8. All of the following can act as Brønsted-Lowry acid (proton donors) in aqueous solution except:

- A) HI B) HCO_3^- C) H_2S D) NH_3

9. Which of the reactions shown below represents an oxidation-reduction reaction?

- A) $\text{Ca}^{2+} + \text{CO}_3^{2-} \rightarrow \text{CaCO}_3$
B) $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3$
C) $\text{Fe}^+ + \text{Cu}^{2+} \rightarrow \text{Fe}^{2+} + \text{Cu}$
D) $\text{CaCO}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{Ca}(\text{HCO}_3)_2$

10. Of the compounds below, in which one does nitrogen have the highest oxidation number?

- A) NH_3 B) HNO_3 C) NaNO_2 D) NO_2

11. The reverse of the neutralization reaction is called:

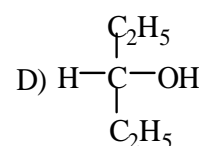
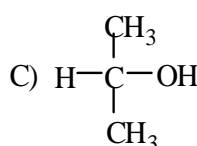
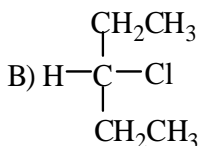
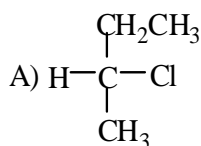
- A) hydration B) esterification C) hydrolysis D) electrolysis

12. Which of the metals does not react with diluted H_2SO_4 ?

- A) Cu B) Ni C) Mg D) Cr

13. All of the following statements about carbon dioxide are true except:
 A) it can be prepared by the action of acid on limestone
 B) it is used to extinguish fires
 C) it dissolves in water at room temperature
 D) it sublimates rather than melts at 20°C and 1 atmosphere pressure
14. The reaction of sulfur and oxygen is the best presented by the equation:
 A) $2 S + O_2 \rightarrow 2 SO$
 B) $S + O_2 \rightarrow SO_2$
 C) $S + 2O_2 \rightarrow SO_4$
 D) $S + O \rightarrow SO$
15. The reaction between magnesium and diluted sulfuric acid produces:
 A) O_2
 B) H_2
 C) SO_3
 D) SO_2
16. Which formula represents a saturated hydrocarbon?
 A) C_2H_2
 B) C_2H_4
 C) C_3H_6
 D) C_3H_8
17. Compounds that have the same composition but differ in their structural formulas:
 A) are called isomers
 B) are called polymers
 C) have the same properties
 D) are usually alkanes
18. The reaction $C_2H_4 + H_2 \rightarrow C_2H_6$ is an example of:
 A) elimination
 B) substitution
 C) addition
 D) condensation
19. Considering the Markovnikov's rule, which of the following is the major product of the reaction between 2-methyl-2-butene and HCl?
- A) $CH_3-CH_2-\overset{\overset{CH_3}{|}}{C}Cl-CH_3$
 B) $CH_3-\overset{\overset{Cl}{|}}{C}H-\overset{\overset{CH_3}{|}}{C}H-CH_3$
 C) $CH_2Cl-CH_2-\overset{\overset{CH_3}{|}}{C}H-CH_3$
 D) $CH_3-CH_2-\overset{\overset{CH_2Cl}{|}}{C}H-CH_3$
20. The compound $CH_3COOC_2H_5$ is classified as:
 A) hydrocarbon
 B) ester
 C) alcohol
 D) acid
21. Which organic structure is ethanoic acid?
 A) $CH_3CH_2C(=O)OH$
 B) $CH_3C(=O)OH$
 C) $HC(=O)OH$
 D) $CH_3CH(CH_3)C(=O)OH$
22. Which of the following reactions does **not** produce salt?
- A) $\text{C}_6\text{H}_5\text{OH} + \text{NaOH} \longrightarrow$
 B) $\text{HCOOH} + \text{Na}_2\text{CO}_3 \longrightarrow$
 C) $\text{CH}_3\text{CH}_2\text{NH}_2 + \text{H}_2\text{SO}_4 \longrightarrow$
 D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{NaOH} \longrightarrow$

23. Which of the following compounds has an enantiomer?

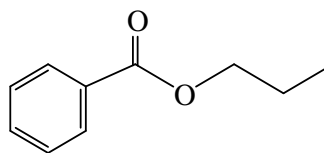


24. Addition of hydrogen to aldehydes produces:

- A) secondary alcohols
C) primary alcohols

- B) carboxylic acids
D) alkanes

25. According to IUPAC rules, the name of the molecule



is:

- A) phenyl propanoate
C) propanoyl benzene

- B) benzyl propanoate
D) propyl benzoate

26. Which compound is an amide?

- A) $\text{C}_6\text{H}_5\text{-CONH}_2$
C) $\text{C}_6\text{H}_5\text{-CH}_2\text{-NH-C}_6\text{H}_5$

- B) $\text{C}_6\text{H}_5\text{-CN}$
D) $\text{C}_6\text{H}_5\text{-COONH}_2$

27. Starch molecules are built of:

- A) α -D-glucose and α -D-manose
C) α -D-glucose

- B) α - and β -D-glucose
D) β -D-glucose

28. Which of these is a secondary amine?

- A) $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3-\text{C}-\text{NH}_2 \end{array}$
C) $\text{CH}_3\text{CH}_2\text{NH}_2$

- B) $\begin{array}{c} \text{CH}_2\text{CH}_3 \\ | \\ \text{CH}_3\text{CH}_2\text{NCH}_2\text{CH}_3 \end{array}$
D) $\text{CH}_3\text{CH}_2\text{NHCH}_3$

29. Decarboxylation of heptanoic acid produces carbon dioxide and:

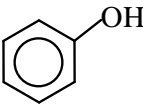
- A) hexane B) benzene C) cyclohexane D) hexene

30. Peptides are:

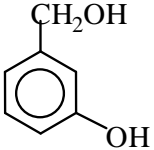
- A) products of amino acids polymerization
B) polyamides of amino acids
C) polyesters of amino acids
D) salts obtained after neutralization of amino groups with carboxylic groups of amino acids

TEST 7

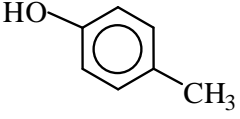
- Which is inconsistent with the concept of an isotope?
A) same atomic number B) different number of neutrons
C) same mass number D) same number of protons
- Which of the following isotopes has the greatest number of neutrons?
A) ${}_{17}^{35}\text{Cl}$ B) ${}_{15}^{31}\text{P}$ C) ${}_{18}^{40}\text{Ar}$ D) ${}_{20}^{41}\text{Ca}$
- The elements that display the greatest nonmetallic character are located toward which corner of the periodic table?
A) upper left B) lower right C) lower left D) upper right
- Which compound contains no ionic character?
A) NH_4Cl B) CO C) Na_2O D) Na_2CO_3
- Which of these describes the rate of the chemical reaction $\text{I}_2 + \text{H}_2 \rightarrow 2 \text{HI}$?
A) an increase in the concentration of HI and H_2 with time
B) an increase in the concentration of HI with time
C) an increase in H_2 and I_2 with time
D) a decrease in HI and I_2 with time
- The reaction of nitric oxide with hydrogen at 1280°C is:
 $2\text{NO}_{(\text{g})} + 2\text{H}_{2(\text{g})} \rightarrow \text{N}_{2(\text{g})} + 2\text{H}_2\text{O}_{(\text{g})}$. If the pressure is increased twice, the rate of reaction will increase by:
A) twice B) 4 times C) 8 times D) 16 times
- Which of the reaction shown below involves the formation of an ionic precipitate from a solution?
A) $\text{Ca}^{2+} + \text{CO}_3^{2-} \longrightarrow \text{CaCO}_3$ B) $\text{HCO}_3^- + \text{H}^+ \longrightarrow \text{H}_2\text{CO}_3$
C) $\text{Fe} + \text{Cu}^{2+} \longrightarrow \text{Fe}^{2+} + \text{Cu}$ D) $\text{CaCO}_3 + \text{H}_2\text{CO}_3 \longrightarrow \text{Ca}(\text{HCO}_3)_2$
- Given the following process that has reached equilibrium: $\text{NaCl}(\text{s}) \rightleftharpoons \text{NaCl}(\text{aq})$. For the phase equilibrium to exist, the $\text{NaCl}(\text{aq})$ must be a solution that is:
A) concentrated B) saturated C) supersaturated D) unsaturated
- Species that, in water, can function as both, a Brønsted acid and a Brønsted base include which of the following?
A) HClO_4 B) H_2CO_3 C) HCO_3^- D) CO_3^{2-}
- Which of the following dilute solutions has the highest concentration of OH^- ions?
A) 0.010 mol/L HCl B) 0.010 mol/L NaOH
C) 0.010 mol/L CH_3COOH D) 0.010 mol/L NH_4OH
- All of the following statements about HNO_3 are true except:
A) it is strong oxidizing agent B) it reacts with CaO
C) it is highly corrosive D) its salts are called nitrites
- Which of the oxides does not react with CO_2 ?

13. Of the compounds below, in which one does chlorine have the highest oxidation number?
 A) HCl B) KClO₄ C) HOCl D) CaCl₂
 A) Na₂O B) SO₂ C) CaO D) K₂O
14. Which of these reactions shows only reduction?
 A) $\text{Cu}^{2+} + 2\text{e}^- \longrightarrow \text{Cu}$ B) $\text{Fe}_2\text{O}_3 + 3\text{CO} \longrightarrow 2\text{Fe} + 3\text{CO}_2$
 C) $\text{HCl} + \text{NaOH} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$ D) $\text{Mg} + \text{ZnSO}_4 \longrightarrow \text{Zn} + \text{MgSO}_4$
15. Which substance is manufactured by heating limestone?
 A) Ca(OH)₂ B) CaO C) CaC₂ D) Na₂CO₃
16. The third member of alkyne series is:
 A) methyne B) ethyne C) propyne D) butyne
17. Molecules of 1-propanol and 2-propanol have different:
 A) percentage compositions B) molecular masses
 C) molecular formulas D) structural formulas
18. Which two compounds are **not** isomers of each other?
 A) CH₃CH₂CH₂Cl и CH₃CHClCH₃ B) CH₃CH₂OH и CH₃OCH₃
 C) CH₃COOH и CH₃CH₂COOH D) CH₃COCH₃ и CH₃CH₂CHO
19. All carbon-carbon bonds in saturated hydrocarbon molecules are:
 A) single covalent B) double covalent
 C) triple covalent D) coordinative covalent
20. The compound $\begin{array}{cccc} & & \text{CH}_3 & \\ & & | & \\ \text{CH}_3 & -\text{CH}_2 & -\text{CH} & -\text{CH}_3 \\ 1 & 2 & 3 & 4 \end{array}$ contains different hydrogen atoms numbered with 1, 2, 3 and 4. Which hydrogen is most easily abstracted in a radical bromination reaction?
 A) 1 B) 2 C) 3 D) 4
21. For the polymer polyvinyl chloride $\sim(\text{CH}_2\text{CH}(\text{Cl})\text{CH}_2\text{CH}(\text{Cl})\text{CH}_2\text{CH}(\text{Cl}))\sim$ the repeating subunit is:
 A) CH(Cl) B) CH(Cl)CHCH₂ C) CH₂CH(Cl) D) CH₂CH
22. A molecule of which alcohol contains more than one hydroxyl group?
 A) propanol B) butanol C) pentanol D) glycerol
23. Oxidation of pentanal produces:
 A) pentanol B) pentanoic acid C) pentanone D) pentanoate
24. Which of the following compounds is **not** a phenol?
- 

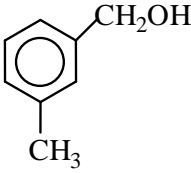
A)



B)

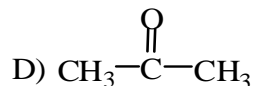
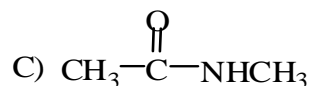
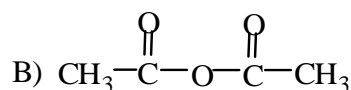
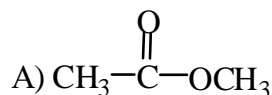


C)

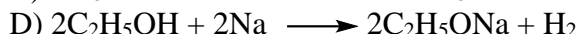
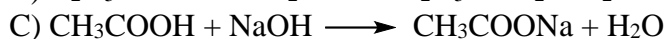
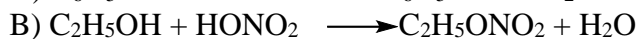
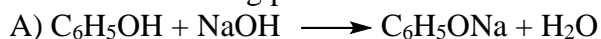


D)

25. Which structure contains an ester grouping?



26. Which of the following processes is esterification?



27. Fat molecules contain atoms of:

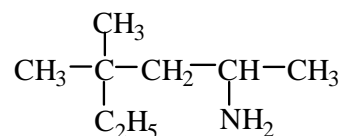
A) carbon, hydrogen and nitrogen

B) carbon, oxygen and hydrogen

C) carbon and hydrogen

D) carbon, oxygen and nitrogen

28. The correct name of the compound below is:



A) 3,3-dimethyl-5-aminohexane

B) 2-amino-4,4-dimethylhexane

C) 2-ethyl-2-methyl-4-aminopentane

D) 4-ethyl-4-methyl-2-aminopentane

29. Glucose and fructose are:

A) enantiomers

B) functional isomers

C) tautomers

D) chain isomers

30. When the amine group of one amino acid reacts with the carboxylic acid group of another amino acid, the functional group formed is called:

A) amine

B) peptide

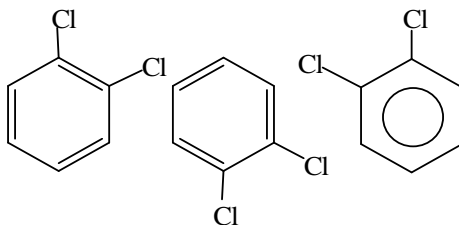
C) ester

D) polymer

TEST 8

1. Which pair of symbols below shows different isotopes of the same element?
A) $^{39}_{18}\text{A}$ и $^{39}_{19}\text{R}$ B) $^{60}_{27}\text{X}$ и $^{59}_{28}\text{Y}$ C) $^{12}_6\text{L}$ и $^{14}_6\text{L}$ D) $^{37}_{17}\text{X}$ и $^{37}_{17}\text{X}$
2. As the elements of period 2 are considered from left to right, there is generally a decrease in:
A) ionization energy B) electronegativity
C) metallic character D) nonmetallic character
3. Element X is in Group I of the periodic table. X reacts with element Y to form an ionic compound. Which equation shows the process that takes place when X forms ions?
A) $\text{X} + \text{e}^- \rightarrow \text{X}^+$ B) $\text{X} - \text{e}^- \rightarrow \text{X}^-$ C) $\text{X} + \text{e}^- \rightarrow \text{X}^-$ D) $\text{X} - \text{e}^- \rightarrow \text{X}^+$
4. Which molecule is a nonpolar molecule?
A) NH_3 B) CH_3OH C) CO_2 D) H_2O
5. Allows solids to conduct electricity:
A) hydrogen bonding B) ionic bonding
C) metallic bonding D) polar covalent bonding
6. Which change will cause an increase in the rate of reaction $\text{CH}_4 + \text{Br}_2 \rightarrow \text{CH}_3\text{Br} + \text{HBr}$?
A) increasing the concentration of Br_2 B) decreasing the concentration of CH_4
C) increasing the concentration of HBr D) decreasing the temperature
7. Which takes place when a catalyst is added to a reaction at equilibrium?
A) the point of equilibrium is shifted to the right
B) the point of equilibrium is shifted to the left
C) the forward and reverse reactions rates are increased unequally
D) the forward and reverse reactions rates are increased equally
8. Which of the following changes to the equilibrium $2 \text{NOCl}_{(\text{g})} \rightleftharpoons 2 \text{NO}_{(\text{g})} + \text{Cl}_{2(\text{g})}$ would serve to decrease the concentration of Cl_2 ?
A) increasing the pressure
B) decreasing the pressure
C) increasing the concentration of NOCl
D) decreasing the concentration of NO
9. Which of the following is an observable property of many acids?
A) they become slippery when reacting with water
B) they react with metals to release hydrogen gas
C) they produce salts when mixed with other acids
D) they become more acidic when mixed with a base
10. Which pH value demonstrates a solution with the greatest concentration of H^+ ions?
A) 1 B) 5 C) 10 D) 14
11. Which of the reactions shown below represents a Brønsted acid-base reaction?
A) $\text{Ca}^{2+} + \text{CO}_3^{2-} \rightarrow \text{CaCO}_3$ B) $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3$
C) $\text{Fe} + \text{Cu}^{2+} \rightarrow \text{Fe}^{2+} + \text{Cu}$ D) $\text{CaCO}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{Ca}(\text{HCO}_3)_2$

12. When an ionic compound is dissolved in water, the particles in solution can be best described as:
 A) hydrated molecules only
 B) both hydrated molecules and ions
 C) dehydrated molecules and ions
 D) hydrated ions only
13. Which of the following dilute solutions has a freezing point closest to 0°C?
 A) 0.010 mol/L CuSO₄
 B) 0.010 mol/L CH₃COOH
 C) 0.010 mol/L FeCl₃
 D) 0.010 mol/L Na₂SO₄
14. Of the compounds below, in which one does hydrogen have the lowest oxidation number?
 A) NH₃
 B) H₂
 C) NaH
 D) HCl
15. All of the following are true of aluminum except:
 A) it is good conductor of electricity
 B) it is a metal of high density
 C) it is a good reducing agent
 D) its hydroxide is soluble in both, strong base and acid
16. The general formula for the alkyne series is:
 A) C_nH_n
 B) C_nH_{2n}
 C) C_nH_{2n+2}
 D) C_nH_{2n-2}
17. The compound C₄H₉OH is an isomer of:
 A) C₃H₇COCH₃
 B) C₂H₅OC₂H₅
 C) CH₃COOC₂H₅
 D) CH₃COOH
18. The reagent than can be used to distinguish between pentane and pentene is:
 A) Br₂ (aq)
 B) Cu(OH)₂
 C) FeCl₃
 D) HCl
19. What could be the name of a compound that has the general formula R-OH?
 A) a carboxylic acid
 B) an alkane
 C) an ester
 D) an alcohol
20. A reaction between an acid and alcohol produces an ester and:
 A) CO₂
 B) water
 C) glycerol
 D) ethanol
21. Slight oxidation of a primary alcohol gives:
 A) a ketone
 B) an organic acid
 C) an ether
 D) an aldehyde
22. The structures shown below are:



- A) one and the same compound
 B) homologues
 C) stereoisomers
 D) constitutional isomers

23. Which of the following substituents is **not** an ortho, para director in an electrophilic aromatic substitution reaction?

- A) $-\text{CH}_3$ B) $-\text{NHCCH}_3$ C) $-\text{OH}$ D) $-\text{CNH}_2$

24. A carbonyl group is present in all of these functional groups except:

- A) ethers B) esters C) aldehydes D) ketones

25. Which of the following equations represents a condensation reaction?

- A) $\text{CH}_3\text{CH}_2\text{CH}_3 + \text{Br}_2 \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{HBr}$
 B) $\text{CH}_3\text{CH}=\text{CH}_2 + \text{HBr} \rightarrow \text{CH}_3-\text{CH}_2-\text{CH}_2\text{Br}$
 C) $\text{CH}_3\text{CH}_2\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{CH}_2\text{COONa} + \text{H}_2\text{O}$
 D) $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{COOCH}_2\text{CH}_3 + \text{H}_2\text{O}$

26. What is the name of the compound $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_3$?

- A) ethyl ethanoate B) methyl ethanoate
 C) ethyl methanoate D) methyl propanoate

27. Which compound is an ether?

- A) CH_3COOH B) CH_3CHO C) CH_3OCH_3 D) $\text{CH}_3\text{COOCH}_3$

28. Hydrolysis of sucrose produces:

- A) glucose and fructose B) two molecules fructose
 C) glucose and ribose D) two molecules glucose

29. All of the native α -amino acids can react with the reagents below except:

- A) NaOH B) Ag_2O C) HCl D) glycine

30. Proteins are large macromolecules composed of thousands of subunits. The structure of the protein depends on the sequence of:

- A) lipids B) monosaccharides
 C) amino acids D) nucleosides

TEST 9

1. ^{14}C and ^{14}N have the same mass number. Therefore, they are:
A) isotopes B) isobars C) isomers D) isotopic isomers
2. The modern periodic table is arranged based upon atomic:
A) radius B) mass C) density D) number
3. The forces of attraction that exist between nonpolar molecules are called:
A) covalent bonds B) Van der Waals forces
C) ionic bonds D) electrovalent bonds
4. What type of bond do all of the molecules of H_2 , O_2 , NH_3 , and CO have in common?
A) covalent B) ionic C) metallic D) polar
5. A catalyst can speed up the rate of a given chemical reaction by:
A) increasing the equilibrium constant in favor of products
B) lowering the activation energy required for the reaction to occur
C) raising the temperature at which the reaction occurs
D) increasing the pressure of reactants, thus favoring products
6. When the equation representing the reaction $\text{Al}_{(s)} + \text{O}_{2(g)} \rightarrow \text{Al}_2\text{O}_{3(s)}$ is completed and balanced and all coefficients are reduced to the lowest whole-number terms, the coefficient of $\text{O}_{2(g)}$ is:
A) 1 B) 2 C) 3 D) 4
7. Which of the following dilute solutions has a boiling point closest to 100°C ?
A) 0.010 mol/L CuSO_4 B) 0.010 mol/L CH_3COOH
C) 0.010 mol/L FeCl_3 D) 0.010 mol/L Na_2SO_4
8. The temperature of the system at equilibrium $2 \text{SO}_2(g) + \text{O}_2(g) \rightleftharpoons 2 \text{SO}_3(g) + \text{heat}$, is decreased. When the equilibrium is reestablished, the amount of which compound is increased?
A) both, $\text{O}_2(g)$ and $\text{SO}_2(g)$ B) $\text{O}_2(g)$
C) $\text{SO}_2(g)$ D) $\text{SO}_3(g)$
9. In the ionic solid NH_4NO_3 , the ions present are:
A) NH_3 , H^+ и NO_3^- B) N^{5+} , H^+ и O^{2-}
C) NH_4^+ , N^{5+} и O^{2-} D) NH_4^+ и NO_3^-
10. In the reaction $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$ sulfur atom is:
A) a reducing agent and oxidizes B) a reducing agent and reduces
C) an oxidizing agent and oxidizes C) an oxidizing agent and reduces
11. Which one of the following processes describes the electrolytic dissociation of H_2SO_4 ?
A) $\text{H}_2\text{SO}_4 \rightarrow 2\text{H}^+ + 4\text{SO}_2^-$ B) $\text{H}_2\text{SO}_4 \rightarrow \text{H}^+ + \text{SO}_4^-$
C) $\text{H}_2\text{SO}_4 \rightarrow 2\text{H}^+ + \text{SO}_4^{2-}$ D) $\text{H}_2\text{SO}_4 \rightarrow \text{H}^{2+} + \text{SO}_4^{2-}$
12. Which acid reacts with ammonia to produce the salt ammonium sulfate?
A) hydrochloric B) nitric C) phosphoric D) sulfuric

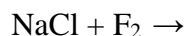
13. Of the compounds below, in which one does sulfur have the lowest oxidation number?

- A) H_2SO_4 B) H_2S C) SO_2 D) Na_2SO_3

14. A product of neutralization of a strong acid with a strong base is:

- A) KI B) AgNO_3 C) CaCO_3 D) CuSO_4

15. What are the products of the following reaction?



- A) $\text{ClF}_2 + \text{Na}$ B) $\text{NaF} + \text{Cl}_2$ C) $\text{NaF}_2 + \text{Cl}$ D) $\text{NaF} + \text{Cl} + \text{F}$

16. The third member of alkene series is:

- A) methene B) ethene C) propene D) butene

17. Compounds which have the same molecular formula but different molecular structures are called:

- A) isomers B) isotopes C) allotropes D) homologs

18. The fermentation of glucose will produce carbon dioxide and:

- A) a polymer B) a soap C) an ester D) an alcohol

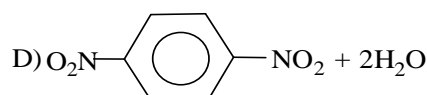
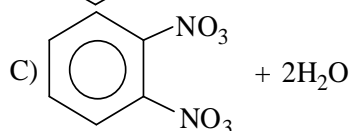
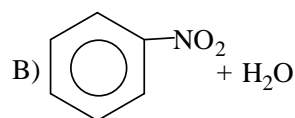
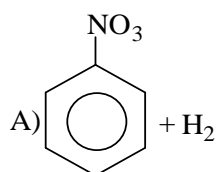
19. Ethyl formate can be produced by heating conc. H_2SO_4 , ethanol and formic acid. This type of reaction is called:

- A) fermentation B) saponification C) polymerization D) esterification

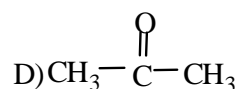
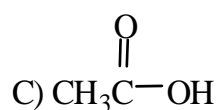
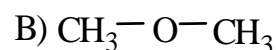
20. Oxidation of primary alcohols produces:

- A) aldehydes B) ketones C) diols D) esters

21. Products of the reaction between benzene and nitric acids are:

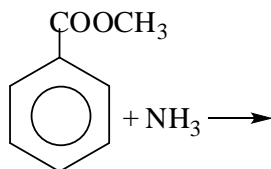


22. Which organic structure is propanone?



23. The reagent than can be used to distinguish between pentanal and pentanone is
 A) Ag_2O B) FeCl_3 C) PbS D) AgCl

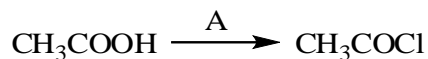
24. What is the product of the reaction?



A) aniline B) benzoic acid C) benzamide D) methylamine

25. Primary amines react with carbonyl compounds. The products obtained are called:
 A) nitriles B) nitrates C) diazonium salts D) imines

26. What should be used as the reagent A in the reaction:



A) Cl_2 B) HCl C) PCl_3 D) FeCl_3

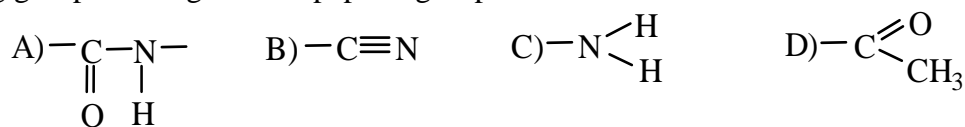
27. Glucose and fructose are:

A) monosaccharides B) disaccharides
 C) aldehydes D) ketones

28. All natural amino acids have L-configuration except:

A) alanine B) glycine C) lysine D) cysteine

29. Amino acids are linked by peptide bonds to form polypeptide chains. Which of the following groups is assigned as a peptide group?

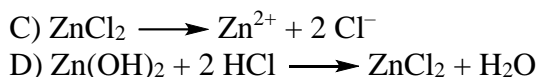


30. Both cellulose and proteins are classified as:

A) carboxylic acids B) esters C) polymers D) anhydrides

TEST 10

- Which of the following statements is **false** regarding sub-atomic particles?
 - the proton has a positive one charge
 - the neutron has no charge
 - the electrons have a greater mass than the protons
 - protons and neutrons are the nucleons of the atom
- A neutral atom, atomic number 33 and atomic mass 75, contains:
 - 75 neutrons
 - 42 electrons
 - 33 protons
 - 75 electrons
- Which kind of bonding can be found in a sample of H₂O?
 - hydrogen bonds only
 - nonpolar covalent bonds only
 - ionic and hydrogen bonds
 - both polar covalent and hydrogen bonds
- The SiCl₄ molecule is nonpolar and chlorine is more electronegative than silicon. From this information alone it can be deduced that the:
 - Si-Cl bond is nonpolar
 - SiCl₄ molecule is linear
 - SiCl₄ molecule is planar
 - SiCl₄ molecule is symmetrical
- If the reaction $\text{N}_2 + 3 \text{H}_2 \rightarrow 2\text{NH}_3$ takes place inside a sealed reaction container, then which of these procedures will cause a decrease in the rate of reaction?
 - raising the temperature of the reaction container
 - increasing the volume inside the reaction container
 - removing the NH₃ as it is formed
 - adding more N₂ to the reaction container
- Which action will drive the reaction $4 \text{HCl}_{(g)} + \text{O}_2_{(g)} \rightleftharpoons 2 \text{H}_2\text{O}_{(l)} + 2 \text{Cl}_2_{(g)}$ to the right?
 - heating the equilibrium mixture
 - adding water to the system
 - decreasing the oxygen concentration
 - increasing the system's pressure
- A solution of salt in 100 g of water that still dissolve more solute at a given temperature is classified as:
 - unsaturated
 - supersaturated
 - dilute
 - saturated
- Which is true about a solution that is acidic?
 - [H⁺] equals zero
 - [OH⁻] equals [H⁺]
 - [H⁺] is less than [OH⁻]
 - [H⁺] is greater than [OH⁻]
- Which of the following solutions of equal concentration will have a 2-times higher osmotic pressure than that of a sucrose solution of the same concentration?
 - KCl
 - K₂SO₄
 - AlCl₃
 - K₃PO₄
- Which of the reactions below represents an oxidation-reduction reaction?
 - $\text{Zn} + 2 \text{HCl} \longrightarrow \text{ZnCl}_2 + \text{H}_2$
 - $\text{ZnCl}_2 + 2 \text{NaOH} \longrightarrow \text{Zn}(\text{OH})_2 + 2 \text{NaCl}$

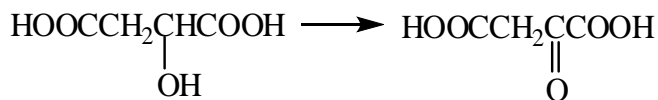


11. Of the compounds below, in which one does iron have the lowest oxidation number?
 A) Fe B) FeCl_3 C) FeSO_4 D) $\text{Fe}(\text{CH}_3\text{COO})_2$
12. According to the reaction represented by the unbalanced equation below, how many moles of $\text{H}_2(\text{g})$ are required to react completely with 1 mole of $\text{N}_2(\text{g})$?

$$\text{N}_2 + \text{H}_2 \longrightarrow \text{NH}_3$$

 A) 0.5 mol B) 1 mol C) 2 mol D) 3 mol
13. If the pH value of a salt solution is 7, most likely this is a solution of:
 A) Na_2CO_3 B) KCl C) KCN D) NH_4Cl
14. Which of these is a base according to Lewis theory for acid and bases?
 A) NaOH B) $\text{Ca}(\text{OH})_2$ C) NH_3 D) $\text{Zn}(\text{OH})_2$
15. Which substance is used in electrical wiring?
 A) iron B) copper C) aluminum D) nickel
16. Which compound is a member of the alkene series?
 A) benzene B) acetylene C) toluene D) ethene
17. Which of the following is not an isomer of the other three compounds?
 A) 3-ethyl-3-methyl-1-hexene B) 2,5-dimethyl-3-hexene
 C) 4-octene D) 4-ethyl-1-hexene
18. Ethene is used to make ethanol. Which of these reactions is used to make ethanol from ethene?
 A) catalytic hydration B) fermentation
 C) oxidation using oxygen D) reduction using hydrogen
19. Which compound is most likely to react by addition?
 A) CH_4 B) C_3H_6 C) C_4H_{10} D) C_5H_{12}
20. The compound 2-propanol is classified as a:
 A) primary alcohol B) secondary alcohol
 C) tertiary alcohol D) diol
21. Which statement is **false**?
 A) $\text{CH}_3\text{CH}_2\text{NH}_2$ is ethylamine
 B) C_5H_{10} is the molecular formula of cyclopentane and 2-pentene
 C) $\text{CH}_3\text{CHBrCHBrCH}_3$ is 2,3-dibromobutane
 D) $\text{CH}_3\text{CH}_2\text{OH}$ is an ether
22. Oxidation of aldehydes produces:
 A) ketones B) diols C) alcohols D) carboxylic acids

23. The enzyme-catalyzed transformation below, which occurs in the Krebs cycle, is best described as belonging to which of the following categories of reactions?

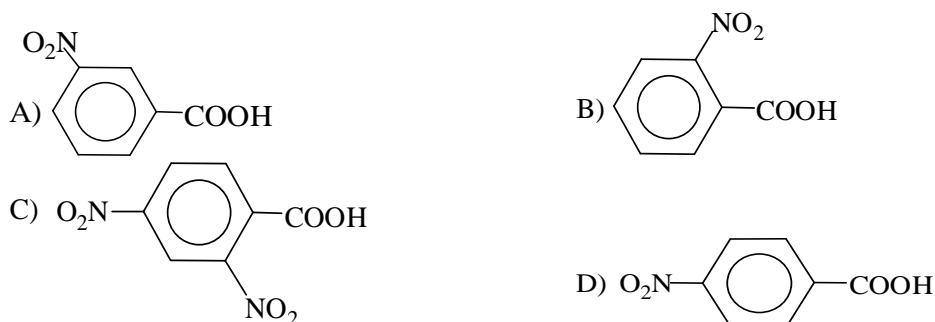


- A) oxidation B) reduction C) hydrolysis D) substitution

24. Hydrolysis of an ester produces:

- A) aldehyde and ketone B) acid
C) acid and alcohol D) alcohol

25. Product of benzoic acid nitration is:



26. Which of the following equations represents an addition reaction?

- A) $\text{CH}_3\text{CH}_2\text{CH}_3 + \text{Br}_2 \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{HBr}$
 B) $\text{HOOC}-\text{CH}=\text{CH}_2 + \text{HBr} \rightarrow \text{HOOC}-\text{CH}_2-\text{CH}_2\text{Br}$
 C) $\text{CH}_3\text{CH}_2\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{CH}_2\text{COONa} + \text{H}_2\text{O}$
 D) $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{COOCH}_2\text{CH}_3 + \text{H}_2\text{O}$

27. The building unit of cellulose is:

- A) α -glucose B) α - and β -glucose C) β -glucose D) α -fructose

28. Which of the following structures represents the amino acid glycine at pH 1?

- A) $\text{H}_2\text{NCH}_2\text{COOH}$ B) $\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-$ C) $\text{H}_2\text{NCH}_2\text{COO}^-$ D) $\text{H}_3\text{N}^+\text{CH}_2\text{COOH}$

29. All of the substances listed below are natural polymers except:

- A) proteins B) nucleic acids
C) polysaccharides D) polyvinyl chloride

30. The products of protein hydrolysis are:

- A) amines B) amino acids
C) amines and esters D) amines and amino acids