

CCl_4 has a highly symmetrical tetrahedral geometry where the individual polar $C - Cl$ bond dipoles cancel each other out, making the overall molecule non-polar.

6. According to Boyle's law, doubling the pressure of a sample of gas, what will be the volume of gas at constant temperature? (1)
- A. Doubled
B. Tripled
C. ✓ Halved
D. One third

Answer: C

According to Boyle's law, pressure and volume are inversely proportional at constant temperature ($P_1V_1 = P_2V_2$), so doubling the pressure halves the volume.

7. The following table shows substance of comparable molecular mass with their dominant intermolecular forces. (1)
- Which of the following is FALSE about the substances?
- A table with two columns and three rows of data:*
- Column 1 header: Substance*
- Column 2 header: Dominant intermolecular force*
- A Hydrogen bonding
B London-dispersion force
C Dipole –dipole force
- A. "B" has the weakest intermolecular force attraction
B. ✓ "C" has the highest boiling point than "A"
C. "A" has the strongest intermolecular force attraction
D. "C" has the strongest intermolecular than "B"

Answer: B

Substance A exhibits hydrogen bonding, which is the strongest intermolecular force among those listed, so A must have a higher boiling point than substance C (which only has dipole-dipole forces).

8. 64g of sulphur dioxide SO_2 is burned in air to produce sulphur trioxide, SO_3 . If the percentage yield of SO_3 is 90%, what is the actual yield of SO_3 ? (1)
- A. 80g
B. ✓ 72g
C. 57.6g
D. 160g

Answer: B

Burning 64 g of SO_2 (1.0 mol) theoretically produces 1.0 mol of SO_3 (80 g). With a 90% yield, the actual yield is $80\text{ g} \times 0.90 = 72\text{ g}$.

9. The following figure shows an energy diagram for a certain chemical reaction (1)
- Which of the following is TRUE about the reaction shown in the diagram?
- [Figure: An energy diagram with vertical axis labeled 'Energy' and horizontal axis labeled 'Course of reaction'. A horizontal plateau at a higher energy level is labeled 'Reactants'. A downward slope connects 'Reactants' to a lower horizontal plateau labeled 'Products'. A dashed horizontal line extends to the right from the 'Reactants' plateau directly above the 'Products' plateau. Double-headed vertical arrow C extends from the horizontal axis up to the 'Reactants' level. Double-headed vertical arrow B extends from the horizontal axis up to the 'Products' level. Double-headed vertical arrow A extends from the dashed line representing the 'Reactants' level down to the 'Products' level.]*
- A. The reaction is endothermic
B. 'C' indicates heat content of product
C. ✓ 'A' indicates heat change of the reaction
D. 'B' indicates heat content of reactant

Answer: C

The diagram shows an exothermic reaction where the reactants are at a higher energy level than the products, and arrow 'A' represents the difference in enthalpy (ΔH) between them.

10. If the proportions of reactants in a reaction mixture are non-stoichiometric, which of the following statement is true? (1)

- A. ✓ **The quantities of the consumed reactant in the reaction maintain stoichiometric proportion**
- B. The amount of yield is proportional to the amount of excess reactant
- C. The excess reactant is always the one with higher number of moles
- D. The limiting reactant is the one with less number of moles

Answer: A

Even in a non-stoichiometric mixture, the actual amounts of reactants that consume each other during the chemical reaction must always follow the definite stoichiometric proportions of the balanced equation.

11. In an oxidation- reduction reaction, the oxidizing agent is (1)

- A. ✓ **reduced as it gains electrons**
- B. oxidized as it loses electrons
- C. contains an element that undergoes oxidation
- D. brings about reduction but itself oxidized

Answer: A

An oxidizing agent facilitates the oxidation of another substance by accepting electrons, and in doing so, it itself becomes reduced.

12. In each of the four beakers shown below, a 2.0cm strip of magnesium ribbon is added to 100mL of aqueous solution of HCl under the given condition shown (1)

In which beaker will the reaction occur at the fastest rate? In the beaker that contains

[Figure: Four cylindrical beakers are shown side by side, each containing an aqueous HCl solution with different conditions labeled inside: first beaker has '0.2M' and '10°C', second beaker has '0.1M' and '30°C', third beaker has '0.1M' and '10°C', and fourth beaker has '0.2M' and '30°C'.]

- | | |
|-----------------|--------------------------|
| A. 0.1M at 30°C | B. ✓ 0.2M at 30°C |
| C. 0.1M at 10°C | D. 0.2M at 10°C |

Answer: B

Reaction rate increases with both higher concentration of reactants and higher temperature; therefore, the reaction in the beaker containing 0.2 M HCl at 30°C will occur the fastest.

13. The quantity of heat required to convert one mole of a solid into its liquid state is (1)

- | | |
|----------------------------------|----------------------------------|
| A. Molar heat of condensation | B. ✓ Molar heat of fusion |
| C. Molar heat of crystallization | D. Molar heat of sublimation |

Answer: B

The molar heat of fusion is defined as the quantity of heat energy required to change one mole of a substance from the solid state to the liquid state at its melting point.

14. Given the reaction at equilibrium: $X_{2(g)} + 2Y_{2(g)} \rightleftharpoons 2XY_{2(g)} + \text{heat}$ (1)
How the equilibrium reaction does yields high amount of product?
- A. By increasing both the temperature and pressure
B. ✓ **By decreasing the temperature and increasing pressure**
C. By increasing the temperature and decreasing pressure
D. By decreasing both the temperature and pressure

Answer: B

According to Le Chatelier's principle, because the forward reaction is exothermic and results in a decrease in the number of moles of gas, decreasing the temperature and increasing the pressure will both shift the equilibrium to favor the products.

15. Two gases A and B were applied to the two ends of 40 cm long glass tube. The two gases met at a distance of 30 cm from the side where B is applied. Which statement is true about these gases? (1)
- A. The density of A is smaller than the density of B
B. The rate of diffusion of A is faster than the rate of diffusion of B
C. ✓ **The molar mass of A is higher than the molar mass of B**
D. The rate of diffusion of B is slower than the rate of diffusion of A

Answer: C

Gas B traveled 30 cm while gas A traveled only 10 cm in the same time, meaning B diffuses faster than A. By Graham's Law, the faster diffusing gas (B) must have a lower molar mass, so the molar mass of A is higher.

16. Which set of compounds represents a homologous series? (1)
- A. C_2H_6 , C_3H_8 , C_4H_8
B. ✓ **C_2H_6 , C_3H_8 , C_4H_{10}**
C. C_2H_6 , C_3H_8 , C_5H_{10}
D. C_2H_6 , C_3H_8 , C_4H_6

Answer: B

C_2H_6 , C_3H_8 , and C_4H_{10} all belong to the alkane homologous series, which has the general molecular formula C_nH_{2n+2} .

17. Which one of the following is a tertiary alcohol? (1)
- A. 3 – Hexanol
B. 1,2,3 – propanetriol
C. 3 – methyl – 2 – pentanol
D. ✓ **2 – methyl – 2 – propanol**

Answer: D

In 2-methyl-2-propanol, the carbon atom bonded to the hydroxyl ($-OH$) group is directly attached to three other carbon atoms (methyl groups), making it a tertiary alcohol.

18. What is the correct IUPAC name of the compound shown below? (1)
[Figure: A chemical structural formula showing a central carbon chain: CH_3 bonded to C, which is bonded to a Br above, a CH_2-CH_3 group below, and a CH_2 group to the right. The CH_2 group is bonded to a CH group, which has a CH_2-CH_3 group above it and a CH_3 group to its right.]
- A. 2 – bromo – 2,4 – diethyl pentane
B. ✓ **3 – bromo – 3,5 – dimethyl heptane**
C. 3 – bromo – 5 – ethyl – 3 – methyl hexane
D. 2 – bromo – 2 – ethyl – 4 – methyl hexane

Answer: B

The longest continuous carbon chain containing the substituents has 7 carbons (heptane), numbered from the left to give the lowest locants (3, 3, 5) for the bromo and two methyl groups, resulting in 3-bromo-3,5-dimethylheptane.

19. Which of these statements is FALSE about the identification test of saturated and unsaturated hydrocarbons? (1)
- A. Br_2 in CCl_4 is used to identify whether the compound is saturated or not.
 - B. The consumption of hydrogen gas (H_2) by the compound to be tested can be used as reagent for the existence of unsaturated hydrocarbon or not
 - C. The reagent KMnO_4 (Alkaline) can be used to test unsaturated hydrocarbon
 - D. ✓ **The reagent nitric acid (HNO_3) can be used to test unsaturated hydrocarbon**

Answer: D

Nitric acid (HNO_3) is a strong oxidizing/nitrating agent and is not a standard reagent used to differentiate between saturated and unsaturated hydrocarbons, unlike bromine or alkaline permanganate.

20. Alcohol that yield ketones on oxidation are classified as; (1)
- A. Dihydric alcohol
 - B. Trihydric alcohol
 - C. Primary alcohol
 - D. ✓ **Secondary alcohol**

Answer: D

Secondary alcohols contain a hydroxyl group bonded to a carbon that is attached to two other carbons; upon oxidation, they lose hydrogen to form ketones.

21. Which one of the following is Not a ternary acid? (1)
- A. HCN
 - B. ✓ **HF**
 - C. HNO_3
 - D. H_3PO_2

Answer: B

A ternary acid is composed of three different elements (usually hydrogen, oxygen, and another nonmetal), whereas hydrofluoric acid (HF) is a binary acid composed of only two elements (H and F).

22. When an acid reacts with an active metal: (1)
- A. hydronium ion concentration increases
 - B. ✓ **hydrogen gas is produced**
 - C. the metal forms anions
 - D. carbon dioxide gas is produced

Answer: B

Active metals (such as zinc, magnesium, or iron) react with acids in a single displacement reaction to release elemental hydrogen gas (H_2).

23. What is the $[\text{OH}^-]$ of a solution with a pH of 4? (1)
- A. 10^{-4}
 - B. 10^4
 - C. 10^{10}
 - D. ✓ **10^{-10}**

Answer: D

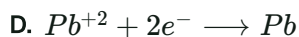
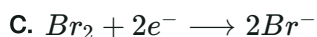
Since $\text{pH} + \text{pOH} = 14$ at 25°C , a solution with a pH of 4 has a pOH of 10, meaning the hydroxide ion concentration $[\text{OH}^-] = 10^{-\text{pOH}} = 10^{-10} \text{ M}$.

24. Which one of the following salts is not an acidic salt? (1)
- A. KHSO_4
 - B. Na_2HPO_4
 - C. ✓ **$(\text{NH}_4)_2\text{SO}_4$**
 - D. $\text{Mg}(\text{HCO}_3)_2$

Answer: C

An acidic salt must contain ionizable hydrogen atoms (e.g., KHSO_4 , Na_2HPO_4 , and $\text{Mg}(\text{HCO}_3)_2$). $(\text{NH}_4)_2\text{SO}_4$ is a normal salt because all replaceable hydrogen atoms of the sulfuric acid have been replaced by ammonium ions, even though its aqueous solution is acidic due to hydrolysis.

25. During the electrolysis of molten lead bromide using graphite electrodes, the anode reaction is (1)



Answer: A

During the electrolysis of molten lead bromide, oxidation occurs at the positive electrode (anode), where bromide ions release electrons to form bromine gas: $2Br^- \rightarrow Br_2 + 2e^-$.

26. As opposed to a galvanic cell, in an electrolytic cell (1)

A. spontaneous redox reaction generates electricity

B. electrons flow from cathode to anode

C. ✓ **the anode is positive**

D. oxidation takes place at the cathode

Answer: C

In an electrolytic cell, the anode is connected to the positive terminal of the external power source and is therefore positive, whereas in a galvanic cell, the anode is the negative electrode.

27. In the extraction of aluminum from bauxite, bauxite is treated with hot aqueous sodium hydroxide. The reason for this is to (1)

A. lower the melting point of bauxite

B. increase the strength of aluminum

C. displace aluminum from its oxide

D. ✓ **remove impurities from bauxite**

Answer: D

Treating bauxite with hot aqueous sodium hydroxide (the Bayer process) dissolves the amphoteric aluminum oxide while leaving insoluble impurities (like iron(III) oxide) behind, effectively removing impurities from the ore.

28. Which of the following is the purest form of iron? (1)

A. Cast iron

B. ✓ **wrought iron**

C. Pig iron

D. limonite

Answer: B

Wrought iron is the purest commercial form of iron, containing less than 0.1% carbon, whereas cast iron and pig iron contain much higher percentages of carbon and other impurities.

29. Which of the following methods is used to reduce land pollution? (1)

A. Replacing CFCs by less harmful alternatives

B. Removal of lead compounds from gasoline

C. Reducing CO₂ emission

D. ✓ **Recycling plastics**

Answer: D

Recycling plastics directly reduces the accumulation of non-biodegradable waste in landfills, thereby mitigating land pollution, while the other options primary target air pollution.

30. In the process of converting skin to leather by tanning, the use of slaked lime is to (1)

A. make sole leather

B. ✓ **remove the hairs**

C. kill bacteria and dehydrate

D. soften the skin and hide

Answer: B

In the leather tanning process, slaked lime (calcium hydroxide) is used during the liming stage primarily to loosen and remove hair and epidermis from the hides.

31. Precision refers to how close a measured value to (1)
- A. the true value
B. ✓ the other measured values
C. zero
D. the calculated value

Answer: B

Precision refers to the closeness of agreement between multiple independent measurements of the same quantity under prescribed conditions, which means how close they are to each other.

32. Which of the following represents a tentative explanation of a certain scientific law? (1)
- A. ✓ Hypothesis
B. Observation
C. Experimentation
D. Theory

Answer: A

A hypothesis is a tentative, testable explanation proposed for a scientific law, observation, or phenomenon before it has been thoroughly tested and established.

33. Which of the following electron transitions requires the highest energy to be absorbed by the hydrogen atom? (1)
- A. ✓ from $n = 1$ to $n = 2$
B. from $n = 3$ to $n = 4$
C. from $n = 2$ to $n = 3$
D. from $n = 4$ to $n = 5$

Answer: A

The energy levels of a hydrogen atom are spaced such that the transition from $n = 1$ to $n = 2$ has the largest energy gap, meaning it requires the absorption of the highest energy photon.

34. Which one of the following quantum numbers determines the orientation of atomic orbitals? (1)
- A. Principal quantum number
B. Spin quantum number
C. Azimuthal (angular) quantum number
D. ✓ Magnetic quantum number

Answer: D

The magnetic quantum number (m_l) determines the orientation of atomic orbitals in space, whereas the principal (n) determines size/energy and the azimuthal (l) determines the shape.

35. Within a specified period, an increase in atomic number's usually accompanies: (1)
- A. an increase in atomic radius and an increase in electronegativity
B. ✓ a decrease in atomic radius and an increase in electronegativity
C. an increase in atomic radius and a decrease in electronegativity
D. a decrease in atomic radius and a decrease in electronegativity

Answer: B

As you move from left to right across a period, the atomic number increases, resulting in a stronger effective nuclear charge that pulls electrons closer (decreasing atomic radius) and increases the tendency to attract shared electrons (increasing electronegativity).

36. Which one of the following is an example of ionic compounds? (1)
- A. NH_3
B. CCl_4
C. NH_3BF_3
D. ✓ CaF_2

Answer: D

Calcium fluoride (CaF_2) is an ionic compound composed of calcium metal cations (Ca^{2+}) and fluoride non-metal anions (F^-), whereas the other choices represent covalent molecular substances or adducts.

37. Which of the following molecules violate octet rule?

(1)

- A. SiCl_4 B. O_3
C. ✓ SF_4 D. SO_3

Answer: C

SF_4 violates the octet rule because the central sulfur atom has 10 valence electrons in its outer shell (4 bonding pairs and 1 lone pair), representing an expanded octet.

38. If a molecule has Trigonal bipyramidal electron pair arrangement and T-shape molecular geometry, how many non-bonding pair of electrons is present in the valence shell of the central atom? (1)

- A. 1 B. ✓ 2
C. 3 D. 0

Answer: B

A T-shaped molecular geometry arises from a trigonal bipyramidal electron-pair arrangement (steric number of 5) containing 3 bonding pairs and 2 non-bonding (lone) pairs of electrons on the central atom.

39. Which reaction involves a change in the hybridization state of the underlined atom?

(1)

- A. $2\underline{\text{S}}\text{O}_2 + \text{O}_2 \rightarrow 2\underline{\text{S}}\text{O}_3$ B. ✓ $\underline{\text{B}}\text{F}_3 + \text{F}^- \rightarrow \underline{\text{B}}\text{F}_4^-$
C. $\text{H}_2\underline{\text{O}} + \text{H}^+ \rightarrow \text{H}_3\underline{\text{O}}^+$ D. $\underline{\text{N}}\text{H}_3 + \text{H}^+ \rightarrow \underline{\text{N}}\text{H}_4^+$

Answer: B

In BF_3 , the boron atom is sp^2 hybridized (trigonal planar), but upon reacting with F^- to form BF_4^- , it gains a fourth bond and adopts an sp^3 hybridized state (tetrahedral).

40. At certain point a reaction: $2\text{A} \rightarrow 3\text{B}$, $[\text{A}]$ drops from 0.4M to 0.2M in 10 minutes. What is the average rate of B during this time interval? (1)

- A. ✓ 0.03M min^{-1} B. 0.02M min^{-1}
C. 0.01M min^{-1} D. 0.06M min^{-1}

Answer: A

The rate of reaction is given by $r = -1/2 \Delta[\text{A}]/\Delta t = 1/3 \Delta[\text{B}]/\Delta t$. Since $\Delta[\text{A}]/\Delta t = -0.02\text{M min}^{-1}$, the rate of formation of B is $-(3/2) * (-0.02) = 0.03\text{M min}^{-1}$.

41. What is the half-life, $t_{1/2}$, for a zero order reaction: $\text{A} \rightarrow \text{B}$, (k is rate constant)? (1)

- A. ✓ $\frac{[\text{A}]_0}{2k}$ B. $\frac{0.693}{k}$
C. $\frac{1}{k[\text{A}]_0}$ D. $\frac{3}{2k[\text{A}]_0}$

Answer: A

For a zero-order reaction, the integrated rate law is $[\text{A}]_t = -kt + [\text{A}]_0$. Setting $[\text{A}]_t = [\text{A}]_0 / 2$ yields the half-life expression $t_{1/2} = [\text{A}]_0 / 2k$.

42. For the reaction $2\text{A}_{(\text{g})} + \text{B}_{(\text{g})} \rightleftharpoons 3\text{C}_{(\text{g})}$ at 200°C , the equilibrium constant is 3.0. If $[\text{A}] = 2.0\text{M}$, $[\text{B}] = 3\text{M}$ and $[\text{C}] = 4.0\text{M}$. Which of the following is correct? (1)

- A. The system is at equilibrium B. The values of $Q_c < K_c$
C. The system shifts towards the right D. ✓ The system shifts towards the left

Answer: D

The reaction quotient is $Q_c = [\text{C}]^3 / ([\text{A}]^2[\text{B}]) = (4.0)^3 / ((2.0)^2 * 3.0) = 64/12 \approx 5.33$. Since $Q_c > K_c$ ($5.33 > 3.0$), the reaction will shift to the left to produce more reactants.

43. What is the relationship between K_c and K_p for the reaction $3A(g) \rightleftharpoons B(g) + C(g)$ (1)
- A. $K_p = K_c(RT)^1$ B. ✓ $K_p = K_c(RT)^{-1}$
 C. $K_p = K_c(RT)^2$ D. $K_p = K_c(RT)^{-2}$

Answer: B

The relationship is $K_p = K_c(RT)^{\Delta n}$. Since $\Delta n = (\text{moles of gaseous products}) - (\text{moles of gaseous reactants}) = (1 + 1) - 3 = -1$, the expression is $K_p = K_c(RT)^{-1}$.

44. What is the general formula of saturated monocarboxylic acids (1)
- A. $C_nH_{2n+1}O$ B. $C_nH_{2n}O$
 C. $C_nH_{2n+2}O_2$ D. ✓ $C_nH_{2n}O_2$

Answer: D

Saturated monocarboxylic acids have one carboxyl group ($-COOH$) attached to an alkyl group (C_nH_{2n+1}). Thus, their molecular formula can be simplified to $C_nH_{2n}O_2$ (where n is the total number of carbon atoms, starting from 1).

45. What is the process that converts vegetable oils to solid fats? (1)
- A. Hydration B. ✓ Hydrogenation
 C. Hydrolysis D. Saponification

Answer: B

Hydrogenation is the chemical addition of hydrogen (H_2) to the carbon-carbon double bonds in unsaturated vegetable oils, which increases their melting point and converts them into solid fats.

46. What is the parent acid and alcohol to prepare isopropyl pentanoate? (1)
- A. $CH_3 - \underset{\text{textOH}}{\underset{|}{CH}} - CH_3$ & $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - OH$
 B. ✓ $CH_3 - \underset{\text{textOH}}{\underset{|}{CH}} - CH_3$ & $CH_3 - CH_2 - CH_2 - \underset{\text{textO}}{\underset{||}{C}} - OH$
 C. $CH_3 - CH_2 \cdot CH_2OH$ & $CH_3 - CH_2 - CH_2 - CH_2 - \underset{\text{textO}}{\underset{||}{C}} - OH$
 D. $CH_3 - CH_2 \cdot CH_2OH$ & $CH_3 - CH_2 - CH_2 - CH_2 - \underset{\text{textO}}{\underset{||}{C}} - OH$

Answer: B

An ester's name is derived from its alkyl group (from the alcohol) and its acyl group (from the carboxylic acid). Isopropyl pentanoate is synthesized from isopropyl alcohol ($CH_3-CH(OH)-CH_3$) and pentanoic acid ($CH_3-CH_2-CH_2-CH_2-COOH$).

47. Which one of the following is not an amphiprotic species? (1)
- A. HPO_4^{2-} B. H_2O
 C. NH_3 D. ✓ HNO_2

Answer: D

An amphiprotic species must be able to both donate and accept a proton. HNO_2 is a weak acid that readily donates a proton but does not act as a proton acceptor in aqueous systems.

48. For the reaction $HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$, which pair of species are both bases? (1)
- A. HCN & CN^- B. H_3O^+ & H_2O
 C. HCN & H_3O^+ D. ✓ H_2O & CN^-

Answer: D

According to the Brønsted-Lowry definition, a base is a proton acceptor. In the forward direction, H_2O accepts a proton to become H_3O^+ , and in the reverse direction, CN^- accepts a proton to become HCN ; hence, H_2O and CN^- are the bases.

49. What is the pH of a 0.01M weak base, B solution? $K_b = 1.6 \times 10^{-9}$ (1)

- A. ✓ 8.6 B. 5.6
C. 4 D. 6

Answer: A

The hydroxide ion concentration of the weak base is calculated using $[\text{OH}^-] = \sqrt{K_b \cdot C_b} = \sqrt{1.6 \times 10^{-9} \cdot 10^{-2}} = 4 \times 10^{-6} \text{ M}$. This gives a pOH of $-\log(4 \times 10^{-6}) = 5.4$, which yields a pH of $14 - 5.4 = 8.6$.

50. The concentration of hydroxide in a solution in which the concentration of hydroxide ion is 100 times hydronium ion at 25°C is ----- (1)

- A. 1.0×10^{-5} B. ✓ 1.0×10^{-6}
C. 1.0×10^{-8} D. 1.0×10^{-9}

Answer: B

Since $[\text{OH}^-] = 100 \times [\text{H}_3\text{O}^+]$ and $K_w = [\text{OH}^-][\text{H}_3\text{O}^+] = 10^{-14}$ at 25°C , substituting the relationship gives $[\text{OH}^-]^2 / 100 = 10^{-14}$, which simplifies to $[\text{OH}^-] = 10^{-6} \text{ M}$.

51. The PH of 0.1M solution of weak acid is 3.0. What is the value of the ionization constant for the acid? (1)

- A. $\checkmark 10^{-5}$ B. 10^{-6}
C. 10^{-8} D. 10^{-10}

Answer: A

A pH of 3.0 means $[H_3O^+] = 10^{-3} \text{ M}$. For a weak acid, K_a is approximately $[H_3O^+]^2 / C_a = (10^{-3})^2 / 0.1 = 10^{-5}$.

52. A buffer solution a mixture of (1)

- A. a weak acid and a strong acid
B. a strong acid and its conjugate base
C. ✓ a weak acid and its conjugate base
D. a strong acid and its conjugate acid

Answer: C

A buffer solution consists of a weak acid and its conjugate base (or a weak base and its conjugate acid) to resist changes in pH when small amounts of acid or base are added.

53. To 0.2 M solution of a weak monoprotic acid, HA, enough quantity of its sodium salt, NaA, was dissolved to give a concentration of 0.2 M of the salt. What will be the acid concentration, $[H_3O^+]$, in the final solutions? (k_a of HA = 1.80×10^{-5})

- A. $3.60 \times 10^{-6} \text{ M}$
B. ✓ **$1.80 \times 10^{-5} \text{ M}$**
C. $1.00 \times 10^{-5} \text{ M}$
D. $190 \times 10^{-3} \text{ M}$

Answer: B

In an equimolar buffer solution of a weak acid and its salt ($[HA] = [A^-] = 0.2 \text{ M}$), the hydronium ion concentration equals K_a , which is $1.80 \times 10^{-5} \text{ M}$.

54. Why salts of weak acid and strong base give a basic solution? because the (1)

- D. ✓ The anions derived from a weak acid can hydrolyzed**

Answer: D

Salts of a weak acid and a strong base contain anions derived from the weak acid, which act as weak conjugate bases and undergo hydrolysis in water to produce hydroxide ions, resulting in a basic solution.

55. Which of the following statements is true?

(1)

- A. ✓ **A universal indicator is a mixture of indicators that will give a different colour for a different pH.**
- B. Phenolphthalein is a universal indicator
- C. A universal indicator can only be used in either strongly acidic or basic solution.
- D. The colour of a universal indicator is red in a weak acid.

Answer: A

A universal indicator is made by mixing several pH indicators so that the mixture displays continuous color changes over a wide range of pH values.

56. Which of the following titrations will have an equivalence point at a pH < 7?

(1)

- A. ✓ **Strong acid with weak base**
- B. Strong acid with strong base
- C. Weak acid with weak base
- D. Weak acid with strong base

Answer: A

The titration of a strong acid with a weak base results in an acidic salt at the equivalence point, which undergoes hydrolysis to produce hydronium ions, leading to a pH less than 7.

57. In titration of acids and bases, the point at which stoichiometrically equal amounts of substances have been brought together is

(1)

- A. End point
- B. Standard point
- C. ✓ **Equivalence point**
- D. common ion

Answer: C

The equivalence point in a titration is the point at which the quantity of titrant added is stoichiometrically equivalent to the quantity of analyte present in the sample.

58. The species that being reduced and causes oxidation is a/an

(1)

- A. Reduction
- B. Reducing agent
- C. Oxidation
- D. ✓ **Oxidizing agent**

Answer: D

An oxidizing agent is the reactant that oxidizes another substance by gaining electrons, meaning the oxidizing agent itself is reduced in the process.

59. Which substances is reduced in the following reaction

(1)



- A. H^+
- B. Cr^{3+}
- C. $\text{S}_2\text{O}_3^{2-}$
- D. ✓ **$\text{Cr}_2\text{O}_7^{2-}$**

Answer: D

In $\text{Cr}_2\text{O}_7^{2-}$, the oxidation state of chromium is +6, which decreases to +3 in Cr^{3+} , indicating that $\text{Cr}_2\text{O}_7^{2-}$ is the species undergoing reduction.

60. What is the difference between metallic conduction and electrolytic conduction? (1)
- A. Metallic conduction involves transfer of matter in the form of ions, whereas electrolytic conduction does not involve transfer of matter.
 - B. In metallic conduction passage of charge brings about physical and chemical changes, whereas electrolytic conduction brings about only physical changes.
 - C. **In metallic conduction electrical charge is carried by electrons, whereas in electrolytic conduction ✓ electrical charge is carried by ions.**
 - D. In metallic conduction the ions are able to move in the solution, whereas in electrolytic conduction delocalized valence electrons are able to move in the solution

Answer: C

The fundamental difference is that metallic conduction relies on the movement of free, delocalized electrons, whereas electrolytic conduction is mediated by the migration of anions and cations.

61. What are the expected products of the electrolysis of an aqueous solution of CuSO_4 using an inert electrode? (1)
- A. Cu and H_2 at the cathode and dissolving of Cu at the anode
 - B. Cu at the cathode and O_2 at the anode only
 - C. Cu and H_2 at the cathode and only O_2 at the anode
 - D. ✓ **Cu at the cathode, O_2 at the anode and H_2SO_4 solution**

Answer: D

During the electrolysis of aqueous CuSO_4 with inert electrodes, Cu^{2+} is reduced to copper metal at the cathode, water is oxidized to O_2 gas at the anode, and the remaining H^+ and SO_4^{2-} ions form sulfuric acid (H_2SO_4) in solution.

62. In the electroplating of nickel from a solution containing Ni^{2+} ion, what will be the weight of the metal deposited on the cathode by a current of 8 A flowing for 500 minutes? (1)
- A. ✓ **73 g**
 - B. 103 g
 - C. 117.4 g
 - D. 145 g

Answer: A

Using Faraday's laws of electrolysis, $Q = I \cdot t = 8 \text{ A} \cdot 30000 \text{ s} = 240,000 \text{ C}$. The moles of electrons is $240,000 / 96500 = 2.487 \text{ mol}$, yielding 1.2435 mol of Ni (since $\text{Ni}^{2+} + 2\text{e}^- \rightarrow \text{Ni}$), which corresponds to $1.2435 \cdot 58.69 \text{ g/mol} = 73 \text{ g}$.

63. A 1M solution of $\text{Cu}(\text{NO}_3)_2$ is placed in a beaker with a strip of Cu metal. A 1M of SnSO_4 is placed in a second beaker with a strip of Sn metal. The two beakers are then connected by a salt bridge and the two metal electrodes are connected by wires to a voltmeter. Which of the following electrode serves as the anode and which electrode gains mass? Given that $E^\circ \text{Cu}^{2+}/\text{Cu} = 0.34\text{V}$ and $E^\circ \text{Sn}^{2+}/\text{Sn} = -0.14\text{V}$ (1)
- A. Sn, Sn electrode gains mass
 - B. Cu, Sn electrode gains mass
 - C. ✓ **Sn, Cu electrode gains mass**
 - D. Cu, Cu electrode gains mass

Answer: C

The Sn electrode serves as the anode because it has the lower reduction potential (-0.14 V vs $+0.34 \text{ V}$ for Cu). Copper ions undergo reduction and deposit onto the copper cathode, causing the Cu electrode to gain mass.

64. Which of the following is WRONG concerning a Galvanic cell? (1)
- A. It involves the deposition of one metal at one electrode when oxidations of another metal occur at the second electrode.
 - B. A spontaneous chemical reaction generates an electric current
 - C. ✓ **A non-spontaneous chemical reaction generates electrical energy**
 - D. It does not require an external source of electric current to function

Answer: C

A Galvanic cell relies on a spontaneous chemical reaction to convert chemical energy into electrical energy; non-spontaneous reactions require an external voltage, characteristic of electrolytic cells.

65. For the electrochemical cell represented by: $\text{Zn(s)}/\text{ZnSO}_4\text{(aq)} // \text{CuSO}_4\text{(aq)}/\text{Cu(s)}$. (1)
- The standard reduction potentials for Cu^{2+}/Cu and Zn^{2+}/Zn are + 0.34 and – 0.76V, respectively. What will be the cell reaction that occurs spontaneously and its cell voltage? $E^\circ(\text{V})$
- A. $\text{Cu} + \text{Zn}^{2+} \longrightarrow \text{Cu}^{2+} + \text{Zn}$ 1.10
 - B. $\text{Zn} + \text{Cu}^{2+} \longrightarrow \text{Zn}^{2+} + \text{Cu}$ 0.42
 - C. $\text{Cu}^{2+} + \text{Zn}^{2+} \longrightarrow \text{Zn} + \text{Cu}$ 0.42
 - D. ✓ **$\text{Cu}^{2+} + \text{Zn} \longrightarrow \text{Cu} + \text{Zn}^{2+}$ 1.10**

Answer: D

The spontaneous cell reaction has a positive standard cell potential of $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = 0.34 - (-0.76) = 1.10$ V, with zinc being oxidized and copper ions being reduced.

66. Which of the following statement describe Chemical industries? It is : (1)
- A. A process in which dissolved solute comes out of solution and form crystals
 - B. An area of chemistry concerned with the rate at which chemical reaction occur
 - C. ✓ **A firm that involves the usage of raw material to form desired products by means of chemical reaction**
 - D. An expression for the chemical composition of compound.

Answer: C

A chemical industry is defined as an entity or firm that transforms raw materials into useful, high-value chemical products using chemical reactions on a large scale.

67. Which of the following is a non-renewable resource: (1)
- A. soil
 - B. ✓ **petroleum**
 - C. water
 - D. plants

Answer: B

Petroleum is a non-renewable fossil fuel because its formation takes millions of years and it cannot be replenished at the rate it is consumed.

68. Which of the following is the most important ingredients used for production of DAP. (1)
- A. ✓ **Ammonia and phosphoric acid**
 - B. Phosphoric acid, urea and ammonia
 - C. Nitric acid and urea
 - D. Sulphuric acid, ammonia and urea

Answer: A

Diammonium phosphate (DAP) is produced by reacting anhydrous ammonia with phosphoric acid, which are the main raw ingredients.

69. The hydrogen used in Haber process is made by the following reaction $CH_4 + H_2O \rightleftharpoons CO + 3H_2$, $\Delta H = +206\text{KJ}$. Which of the following set of condition will favor the formation of more H_2 Molecules? (1)

- A. ✓ **Low pressure and high temperature** B. High pressure and high temperature
C. Low pressure and low temperature D. High pressure and low temperature

Answer: A

Because the forward reaction is endothermic ($\Delta H > 0$), high temperature shifts the equilibrium to the right. Additionally, since the products contain more moles of gas than the reactants, low pressure favors the forward reaction.

70. Ammonia is produced in laboratory by heating ammonium chloride with _____. (1)

- A. Calcium nitrate B. ✓ **Calcium hydroxide**
C. Calcium chloride D. Calcium sulphate

Answer: B

In the laboratory, ammonia gas is commonly prepared by heating a mixture of solid ammonium chloride and calcium hydroxide, yielding calcium chloride, water, and ammonia.

71. Among the following compounds which one is a by-product in Solvay process during the production of Na_2CO_3 ? (1)

- A. ✓ **$CaCl_2$** B. CO_2
C. NH_3 D. $CaCO_3$

Answer: A

Calcium chloride ($CaCl_2$) is formed as a major by-product of the Solvay process when ammonium chloride is treated with calcium hydroxide to regenerate the ammonia.

72. Which of the following pairing is not correct? (1)

- A. ✓ **Solvay process- $NaCl$** B. Ostwald process- HNO_3
C. Contact process- H_2SO_4 D. Haber process- NH_3

Answer: A

The other pairs match industrial processes with their target chemical products (Ostwald produces HNO_3 , Contact produces H_2SO_4 , Haber produces NH_3), whereas the Solvay process produces Na_2CO_3 , making $NaCl$ merely a raw material reactant.

73. What is the purpose of adding ethanol during the preparation of soap? (1)

- A. To reduce the solubility of soap & separate it out
B. ✓ **To dissolve the fat & make hydrolysis easily**
C. To make soft and smooth
D. to make pleasant smell

Answer: B

Ethanol is added during saponification as a mutual solvent to dissolve both the hydrophobic fats/oils and the hydrophilic aqueous sodium hydroxide, facilitating their interaction and accelerating the hydrolysis.

74. The major composition of cement is (1)

- A. SiO_2 B. ✓ **CaO**
C. Fe_2O_3 D. Al_2O_3

Answer: B

Portland cement consists primarily of calcium oxide (CaO), which accounts for approximately 60-67% of its total mass, making it the major component.

75. The purpose of annealing during glass production is _____. (1)
- A. changing into required shapes B. melting the raw material
C. testing the quality of glass D. ✓ **removing internal stress**

Answer: D

Annealing is a process of slow and controlled cooling of glass to prevent thermal shock and relieve internal stresses that could cause the glass to crack or shatter.

76. The stage in which the shredded sugarcane travels on the conveyor belt through a series of heavy-duty rollers, which extract juice from the pulp in sugar manufacturing, is called _____. (1)
- A. ✓ **Juicing** B. Cleansing and Grinding
C. Collecting the Harvest D. Clarifying

Answer: A

The process of extracting juice from sugarcane pulp using a series of heavy-duty rollers is referred to as 'Juicing' (or extraction) in the sugar manufacturing process.

77. In the process of sugar manufacturing which one of the following substance is used to bleach the brown syrup? (1)
- A. Sodium hypochlorite B. ✓ **Sulfur dioxide**
C. Hydrogen peroxide D. Chlorine

Answer: B

Sulfur dioxide (SO₂) is used in the sulfitation process of sugar manufacturing to bleach the juice or syrup and inhibit browning reactions.

78. Of the following methods, which one is a traditional food preservation method? (1)
- A. Vacuum packing B. Freeze drying
C. ✓ **Salting** D. Freezing

Answer: C

Salting is an ancient, traditional method of food preservation that draws moisture out of food through osmosis, inhibiting the growth of microorganisms, whereas vacuum packing and freeze drying are modern techniques.

END OF THE MARKING KEY

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