Answer Key :Chemistry

Type: Chemistry

1) In the industrial production of caustic soda (NaOH), the chemical engineering industry experienced a significant structural shift between 1925 and 1937 due to inter-process competition. Based on the chemical manufacturing data provided, which of the following statements correctly evaluates the economic dynamics of the lime-soda process versus the electrolytic process?

Options:

- 1. A) The lime-soda process is strictly superior because its accessory product pool ($Na_2CO_3, NAHCO_3, NH_4Cl$) eliminates any market risk associated with volatile demand for elemental gas.
- 2.As chlorine market demand expands rapidly, the electrolytic process places a supply-side premium on production, potentially causing caustic soda to transition from a primary product to a willy-nilly joint by-product that threatens to exceed market requirements.
- 3.The electrolytic process is self-limiting because it produces exactly a pound and a quarter of chlorine for every pound of caustic soda, matching historical market growth ratios.
- 4.Inter-process competition indicates that while the production volume of chlorine rose sharply, its market price remained completely rigid and constant, buffering the economic risk of joint production.

Correct Option: 2

Type: Chemistry

2) When modeling the capital lifecycle of advanced chemical manufacturing facilities, specifically those designed for synthetic ammonia, synthetic methanol, and petroleum solvents, which risk profile factor must a chemical plant design engineer weigh most heavily compared to traditional mechanical fabrication industries?

Options:

- 1.The mechanical wear of assembly lines due to the continuous movement of shifting components.
- 2.Low rates of physical equipment depreciation combined with rigid raw material inputs that prevent product substitution.
- 3.Hyper-rapid process and product obsolescence where technical developments crowd so thick and fast that a state-of-the-art plant may become economically obsolete before completion of its physical construction.

- 4.The stability of basic operations provides a comfortable assurance that no radical reaction network changes will force overnight scrapping of heavy equipment capital investments.

Correct Option: 3

Type: Chemistry

3) In the design of large-scale continuous unit operations (such as fractionating columns, vacuum pans, or continuous filters), how does the scaling law of chemical engineering economics alter the relationship between unit plant cost and production output capacity relative to discrete mechanical machining tools?

Options:

- 1.In chemical processing, increasing output capacity requires a perfectly linear scale-up (1:1) of human operator labor and physical tool quantity.
- 2.Continuous automated chemical processing allows operations to be handled in enormously larger unit capacities without a corresponding linear increase in labor costs or plant cost per unit of output.
- 3.Scaled-up chemical units decrease economic efficiency because automatic analytical control systems exhibit diminishing returns as the system approaches continuous automation.
- 4.Mechanical manufacturing processes achieve lower unit costs through automatic operation much more effectively than large-scale continuous fluid flow operations.

Correct Option: 2

Type: Chemistry

4) Ques is:

The solubility of AgCl in water, 0.01 M $CaCl_2$, 0.02 M $CaCl_2$, 0.02 M NaCl and 0.05 M $AgNO_3$ are dented by S_1, S_2, S_3, S_4 respectively. Which of the following relationship is correct?

Options:

- 1.$S1 > S2 > S3 > S4$
- 2.$S1 = S2 = S3 = S4$
- 3.$S1 > S3 > S2 > S1$
- 4.$S1 > S2 = S3 > S4$

Correct Option: 4

Type: Chemistry

5) Ques is:

In a tube of length 5m having 2 identical holes at the opposite ends. H_2 and O_2 are made to effuse into the tube from opposite ends under identical conditions. Find the point where gases will meet for the first time.

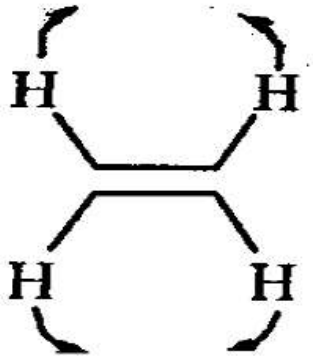
Options:

- 1.4
- 2.3
- 3.1
- 4.12

Correct Option: 1

Type: Chemistry

6) The normal mode of ethylene represented by the figure below, is



Options:

- 1.Only IR active
- 2.Only Raman active
- 3.Both IR and Raman active
- 4.Neither IR nor Raman active

Correct Option: 2

Type: Chemistry

7) Ques is:

What % of the carbon in the $H_2CO_3 - HCO_3^-$ buffer should be in the form of HCO_3^- so as to have a neutral solution? $(K_a = 4 \times 10^{-7})$

Options:

- 1.20%
- 2.40%
- 3.60%

- 4.80%

Correct Option: 4

Type: Chemistry

8) The Debye-Hückel limiting law establishes a mathematical relationship between which of the following variables?

Options:

- 1.Activity of an electrolyte with concentration
- 2.Mean ionic activity coefficient with ionic strength
- 3.Equivalent conductance with viscosity
- 4.Mean molality with ionic atmosphere radius

Correct Option: 2

Type: Chemistry

9) Ques is:

At 25^0C, the constants in the Onsager equation for 1:1 electrolyte are $A = 0.230\ M^{-1/2}$ And $B = 60.50\ \Omega^{-1}cm^2\ mol^{-1}\ M^{-1/2}$. Given the limiting molar ionic conductivities: $\lambda_m^\infty(H^+) = 349.6\ \Omega^{-1}cm^2\ mol^{-1}$, $\lambda_m^\infty(Cl^-) = 76.4\ \Omega^{-1}cm^2\ mol^{-1}$. Calculate the molar conductivity (Λ_m) of a 0.04 M HCl solution?

Options:

- 1.394.30 Ω^−1cm^2 mol^−1
- 2.426.0 Ω^−1cm^2 mol^−1
- 3.31.696 Ω^−1cm^2 mol^−1
- 4.140.42 Ω^−1cm^2 mol^−1

Correct Option: 1

Type: Chemistry

10) A solution of weak base LiOH was titrated with 0.1 M HCl. The pH of the solution was found to be 10.04 and 9.14 after the addition of 5 mL and 20 mL of the acid respectively. Find the dissociation constant of the base.

Options:

- 1.1.91×10^−5
- 2.1.81×10^−5
- 3.1.81×10^−6
- 4.1.91×10^−7

Correct Option: 2

Type: Chemistry

11) What is the wavenumber and wavelength of the first transition in the Lyman Balmer and Paschen series in the atomic spectra of hydrogen?

Options:

- 1.Lyman: 91.2nm, Balmer: 364.6 nm, Paschen: 820.4nm
- 2.Lyman: 121.6 nm, Balmer: 656.3 nm, Paschen: 1875.6nm
- 3.Lyman: 102.6 nm, Balmer: 486.1nm, Paschen: 1281.8 nm
- 4.Lyman: 121.6 nm, Balmer: 434.0nm, Paschen: 1281.8 nm

Correct Option: 2

Type: Chemistry

12) What are the correct geometric arrangements for sp^3d^2, sp^3d, and dsp^2 hybrid orbitals, respectively?

Options:

- 1.Octahedral, Trigonal bipyramidal and Square planar
- 2.Trigonal bipyramidal, Octahedral and Square planar
- 3.Octahedral, Square planar, and Trigonal bipyramidal
- 4.Tetrahedral, Trigonal bipyramidal and Linear

Correct Option: 1

Type: Chemistry

13) Which of the following best explains why the electrical conductivity of a metal decreases with an increase in temperature, whereas the electrical conductivity of a semiconductor increases?

Options:

- 1.In metals, increasing temperature increases the bandgap energy, while in semiconductors, it narrows the bandgap, allowing easier electron movement.
- 2.In metals, thermal energy increases lattice vibrations (phonon scattering) which hinders electron flow; in semiconductors, thermal energy provides enough power to promote valence electrons across the bandgap into the conduction band, outweighing any scattering effects.

- 3.In metals, the concentration of charge carriers drops drastically at high temperatures; in semiconductors, the mobility of charge carriers increases exponentially with temperature.
- 4.In metals, electrons are converted into holes upon heating; in semiconductors, heating generates extra protons that assist in electrical conduction.

Correct Option: 2

Type: Chemistry

14) Even though nuclear charge increases across a period, the first ionization energy drops when moving from Be to B and from Mg to Al. Which statement best explains this anomaly?

Options:

- 1.Electrons in p-orbitals have higher penetration power than s-orbitals, making them harder to remove.
- 2.The outermost electron in B and Al occupies a p-orbital, which is higher in energy and more shielded by inner electrons than an electron in an s-orbital.
- 3.Removing an electron from B and Al disrupts a highly stable half-filled orbital configuration.
- 4.Be and Mg have a lower effective nuclear charge (Zeff) than B and Al, causing their outer electrons to be loosely bound.

Correct Option: 2

Type: Chemistry

15) Which of the following correct lists the hydrogen (HF, HCl, HBr, HI) in order of increasing boiling point?

Options:

- 1.HF < HCl < HBr < HI
- 2.HCl < HBr < HI < HF
- 3.HI < HBr < HCl < HF
- 4.HCl < HF < HBr < HI

Correct Option: 2

Type: Chemistry

16) Who discovered chlorine gas in 1774 by reacting the mineral pyrolusite (MnO_2) with hydrochloric acid (HCl) ?

Options:

- 1.Antoine Lavoisier
- 2.Carl Wilhelm Scheele
- 3.Humphry Davy
- 4.Joseph Priestley

Correct Option: 2

Type: Chemistry

17) In the industrial manufacture of sodium hydroxide (NaOH) via the Nelson cell (diaphragm cell) process, a porous diaphragm of asbestos is used to keep:

Options:

- 1.The sodium ions from reacting with the chloride ions
- 2.The hydrogen gas separated from the oxygen gas
- 3.The chlorine gas separated from the sodium hydroxide and hydrogen gas
- 4.The brine solution from entering the cathode compartment

Correct Option: 3

Type: Chemistry

18) The solubility of the sulphates in water decreases down the group Be, Mg, Ca, Sr, Ba. Which of the following is the correct reason for this trend?

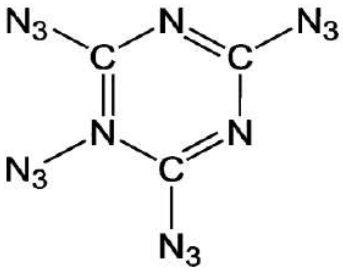
Options:

- 1.Lattice energy increases down the group
- 2.Hydration energy increases down the group
- 3.Lattice energy decreases more rapidly than hydration energy down the group
- 4.Hydration energy decreases more rapidly than the lattice energy down the group

Correct Option: 4

Type: Chemistry

19) Identify the chemical compound represented by the structure shown in the image below:



Options:

- 1.Cyanuric Chloride
- 2.Melamine
- 3.Cyanuric triazide
- 4.Trinitrotoluene (TNT)

Correct Option: 3

Type: Chemistry

20) The compound with the formula CF3CHBrCl ia s well-known volatile inhalation general anesthetic. It is also called as?

Options:

- 1.Fluothane
- 2.Isoflurane
- 3.Chloroform
- 4.Desflurane

Correct Option: 1

Type: Chemistry

21) What are the types of systematic errors?

Options:

- 1.Instrumental errors
- 2.Method errors
- 3.Personal errors
- 4.All of the above

Correct Option: 4

Type: Chemistry

22) Methanol and ethanol are separated in a capillary GC column with retention times of 370 and 385 s, respectively,

and half widths (w1/2) of 9.42 and 10.0 s. An unretained butane peak occurs at 10.0 s. Calculate the separation factor and the resolution.

Options:

- 1.0.81
- 2.0.78
- 3.0.91
- 4.0.9

Correct Option: 3

Type: Chemistry

23) Twenty milliliters of an aqueous solution of 0.10M butyric acid id shaken with 10 mL ether. After the layers are separated, it is determined by titration that 0.5 mmol butyric acid remains in the aqueous layer. What is the distribution ratio?

Options:

- 1.5
- 2.6
- 3.1.2
- 4.4.2

Correct Option: 2

Type: Chemistry

24) In which of his books did the famous chemist and physicist Robert Boyle coin the term "analyst" (which helped lay the groundwork for the field of analytical chemistry)?

Options:

- 1.The Sceptical Chymist
- 2.Experiments and Considerations Touching Colors
- 3.The Aerial Noctiluca
- 4.New Experiments Physico-Mechanical

Correct Option: 1

Type: Chemistry

25) Who is widely recognized as the father of quantitative chemical analysis?

Options:

- 1.Karl Wilhelm Scheele
- 2.Carl Remigius Fresenius
- 3.Antoine Lavoisier
- 4.Wilhelm Ostwald

Correct Option: 3

Type: Chemistry

26) Which of the following statement is not correct?

Options:

- 1.The precipitate is a solid that forms in the mother liquor.
- 2.When a precipitate is formed, the mother liquor passess through the filter and becomes the filtrate.
- 3.The filtrate contains the precipitate, which can be dried and weighed.
- 4..

Correct Option: 3

Type: Chemistry

27) Police have a hit-and-run case and need to identify the brand of red auto paint. What statistical test might they perform?

Options:

- 1.Q-test
- 2.t-test
- 3.F- test
- 4..

Correct Option: 2

Type: Chemistry

28) .....is a process in which a precipitate is heated in the solution from which it was formed (the mother liquor) and allowed to stand in contact with the solution.

Options:

- 1.Coprecipitation
- 2.Peptization
- 3.Digestion (Ostwald ripening)
- 4.Ignition

Correct Option: 3

Type: Chemistry

29) A 100.0 mL sample of brackish water was treated with ammonia and the sulfide it contained was titrated with 16.47 mL of 0.02310 M AgNO3. The analytical reaction is below; Calculate the concentration of H2S in the water in parts per million, Cppm.

$$2Ag^{+} + S^{2-} \rightarrow Ag_2S(s)$$

Options:

- 1.65ppm
- 2.64.8ppm
- 3.67.2ppm
- 4.64.5ppm

Correct Option: 2

Type: Chemistry

30) Which of the following statements correctly distinguishes the electronic transition in a charge-transfer complex from that in a standard organic chromophore?

Options:

- 1.In a charge-transfer complex, the excited electron moves to an orbital shared equally by all atoms, whereas in an organic chromophore, it moves to an orbital localized entirely on a single donor atom.
- 2.In a charge-transfer complex, the excitation results in an internal oxidation/reduction process between a donor and an acceptor, whereas in an organic chromophore, the excited electron remains in a molecular orbital shared by two or more atoms.
- 3.A charge-transfer complex requires the absorption of thermal energy to transfer an electron, whereas an organic chromophore relies exclusively on nuclear radiation.
- 4.The excited state of an organic chromophore involves a complete intermolecular transfer of an electron, whereas a charge-transfer

complex involves only localized vibrational excitation.

Correct Option: 2