NEET 2022 — Chemistry Question Paper with Solutions

46 Chemistry questions as set in the paper · answers checked by RankUp

NEET 2022

1. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R)
Assertion (A) : ICl is more reactive than I_2
Reason (R) : I-Cl bond is weaker than I-I bond.
In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(B) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(C) (A) is correct but (R) is not correct.
(D) (A) is not correct but (R) is correct.

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2. Which compound amongst the following is not an aromatic compound?

(A) Cyclopentadienyl anion ($C_5H_5^-$)
(B) Cycloheptatrienyl (tropylium) cation ($C_7H_7^+$)
(C) Cyclopropenyl cation ($C_3H_3^+$)
(D) Cycloheptatriene (C_7H_8, with one sp^3 CH_2 in the ring)

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3. The IUPAC name of an element with atomic number 119 is

(A) ununennium
(B) unnilennium
(C) unununnium
(D) ununoctium

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4. Match List-I with List-II.
List - I (Hydrides): (a) MgH_2 (b) GeH_4 (c) B_2H_6 (d) HF
List - II (Nature): (i) Electron precise (ii) Electron deficient (iii) Electron rich (iv) Ionic
Choose the correct answer from the options given below:

(A) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)
(B) (a) - (iii), (b) - (i), (c) - (ii), (d) - (iv)
(C) (a) - (i), (b) - (ii), (c) - (iv), (d) - (iii)
(D) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

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5. The incorrect statement regarding enzymes is

(A) Enzymes are biocatalysts.
(B) Like chemical catalysts enzymes reduce the activation energy of bio processes.
(C) Enzymes are polysaccharides.
(D) Enzymes are very specific for a particular reaction and substrate.

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6. The IUPAC name of the complex -
$[Ag(H_2O)_2][Ag(CN)_2]$ is:

(A) dicyanidosilver(II) diaquaargentate (II)
(B) diaquasilver(II) dicyanidoargentate(II)
(C) dicyanidosilver(I) diaquaargentate(I)
(D) diaquasilver(I) dicyanidoargentate(I)

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7. Gadolinium has a low value of third ionisation enthalpy because of

(A) small size
(B) high exchange enthalpy
(C) high electronegativity
(D) high basic character

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8. Amongst the following which one will have maximum 'lone pair - lone pair' electron repulsions?

(A) ClF_3
(B) IF_5
(C) SF_4
(D) XeF_2

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9. Which of the following statement is not correct about diborane?

(A) There are two 3-centre-2-eletron bonds.
(B) The four terminal B-H bonds are two centre two electron bonds.
(C) The four terminal Hydrogen atoms and the two Boron atoms lie in one plane.
(D) Both the Boron atoms are sp^2 hybridised.

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10. Given below are two statements :
Statement I : The boiling points of aldehydes and ketones are higher than hydrocarbons of comparable molecular masses because of weak molecular association in aldehydes and ketones due to dipole - dipole interactions.
Statement II : The boiling points of aldehydes and ketones are lower than the alcohols of similar molecular masses due to the absence of H-bonding.
In the light of the above statements, choose the most appropriate answer from the given below

(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

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11. The incorrect statement regarding chirality is

(A) S_N1 reaction yields 1 : 1 mixture of both enantiomers
(B) The product obtained by S_N2 reaction of haloalkane having chirality at the reactive site shows inversion of configuration
(C) Enantiomers are superimposable mirror images on each other
(D) A racemic mixture shows zero optical rotation

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12. Which of the following sequence of reactions is suitable to synthesize chlorobenzene?

(A) Benzene, Cl_2, anhydrous $FeCl_3$
(B) Phenol, $NaNO_2$, HCl, CuCl
(C) Benzene, HCl
(D) Aniline ($C_6H_5NH_2$), HCl, Heating

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13. Identify the incorrect statement from the following.

(A) All the five 5d orbitals are different in size when compared to the respective 4d orbitals.
(B) All the five 4d orbitals have shapes similar to the respective 3d orbitals.
(C) In an atom, all the five 3d orbitals are equal in energy in free state.
(D) The shapes of dxy, dyz and dzx orbitals are similar to each other; and dx^2-y^2 and dz^2 are similar to each other.

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14. The Kjeldahl's method for the estimation of nitrogen can be used to estimate the amount of nitrogen in which one of the following compounds?

(A) Nitrobenzene ($C_6H_5NO_2$)
(B) Pyridine (C_5H_5N)
(C) Aniline ($C_6H_5NH_2$)
(D) Azobenzene ($C_6H_5–N=N–C_6H_5$)

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15. Given below are two statements:
Statement I: The acidic strength of monosubstituted nitrophenol is higher than phenol because of electron withdrawing nitro group.
Statement II : o-nitrophenol, m-nitrophenol and p-nitrophenol will have same acidic strength as they have one nitro group attached to the phenolic ring.
In the light of the above statements, choose the most appropriate answer from the options given below :

(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

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16. At 298 K, the standard electrode potentials of Cu^{2+}/Cu, Zn^{2+}/Zn, Fe^{2+}/Fe and Ag^{+}/Ag are 0.34 V, −0.76 V, −0.44 V and 0.80 V, respectively.
On the basis of standard electrode potential, predict which of the following reaction cannot occur?

(A) $CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$
(B) $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$
(C) $FeSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Fe(s)$
(D) $2CuSO_4(aq) + 2Ag(s) \rightarrow 2Cu(s) + Ag_2SO_4(aq)$

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17. Given below are two statements
Statement I : Primary aliphatic amines react with HNO_2 to give unstable diazonium salts.
Statement II : Primary aromatic amines react with HNO_2 to form diazonium salts which are stable even above 300 K.
In the light of the above statements, choose the most appropriate answer from the options given below.

(A) Both Statement I and Statement II are correct.
(B) Both Statement I and Statement II are incorrect.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but Statement II is correct.

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18. In one molal solution that contains 0.5 mole of a solute, there is

(A) 500 mL of solvent
(B) 500 g of solvent
(C) 100 mL of solvent
(D) 1000 g of solvent

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19. $RMgX + CO_2 \xrightarrow{\text{(dry ether)}} Y \xrightarrow{(H_3O^+)} RCOOH$
What is Y in the above reaction?

(A) $RCOO^-Mg^+X$
(B) $R_3CO^-Mg^+X$
(C) $RCOO^-X^+$
(D) $(RCOO)_2Mg$

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20. Given below are half cell reactions:
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$, $E°(Mn^{2+}/MnO_4^-) = -1.510$ V
$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$, $E°(O_2/H_2O) = +1.223$ V
Will the permanganate ion, MnO_4^- liberate O_2 from water in the presence of an acid?

(A) Yes, because E°cell = + 0.287 V
(B) No, because E°cell = −0.287 V
(C) Yes, because E°cell = + 2.733 V
(D) No, because E°cell = − 2.733 V

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21. What mass of 95% pure $CaCO_3$ will be required to neutralise 50 mL of 0.5 M HCl solution according to the following reaction?
$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + 2H_2O(l)$
[Calculate upto second place of decimal point]

(A) 1.25 g
(B) 1.32 g
(C) 3.65 g
(D) 9.50 g

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22. The pH of the solution containing 50 mL each of 0.10 M sodium acetate and 0.01 M acetic acid is
[Given pKa of CH_3COOH = 4.57]

(A) 5.57
(B) 3.57
(C) 4.57
(D) 2.57

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23. Match List-I with List-II.
List - I (Products formed): (a) Cyanohydrin (b) Acetal (c) Schiff's base (d) Oxime
List - II (Reaction of carbonyl compound with): (i) NH_2OH (ii) RNH_2 (iii) Alcohol (iv) HCN
Choose the correct answer from the options given below

(A) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)
(B) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)
(C) (a) - (i), (b) - (iii), (c) - (ii), (d) - (iv)
(D) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

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24. Which amongst the following is incorrect statement?

(A) The bond orders of O_2^+, O_2, O_2^- and O_2^{2-} are 2.5, 2, 1.5 and 1, respectively
(B) C_2 molecule has four electrons in its two degenerate π molecular orbitals
(C) H_2^+ ion has one electron
(D) O_2^+ ion is diamagnetic

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25. Given below are two statements:
Statement I : In Lucas test, primary, secondary and tertiary alcohols are distinguished on the basis of their reactivity with conc. HCl + $ZnCl_2$, known as Lucas Reagent.
Statement II : Primary alcohols are most reactive and immediately produce turbidity at room temperature on reaction with Lucas Reagent.
In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Both Statement I and Statement II are correct
(B) Both Statement I and Statement II are incorrect
(C) Statement I is correct but Statement II is incorrect
(D) Statement I is incorrect but Statement II is correct

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26. If radius of second Bohr orbit of the He^+ ion is 105.8 pm, what is the radius of third Bohr orbit of Li^{2+} ion?

(A) 158.7 pm
(B) 15.87 pm
(C) 1.587 pm
(D) 158.7 Å

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27. For a first order reaction A → Products, initial concentration of A is 0.1 M, which becomes 0.001 M after 5 minutes. Rate constant for the reaction in min^{-1} is

(A) 1.3818
(B) 0.9212
(C) 0.4606
(D) 0.2303

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28. The correct IUPAC name of the following compound is
$BrCH_2–CH_2–CH(OH)–CH(CH_3)–CH(Cl)–CH_3$

(A) 1-bromo-5-chloro-4-methylhexan-3-ol
(B) 6-bromo-2-chloro-4-methylhexan-4-ol
(C) 1-bromo-4-methyl-5-chlorohexan-3-ol
(D) 6-bromo-4-methyl-2-chlorohexan-4-ol

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29. The product formed from the following reaction sequence is
C_6H_5CN —(i) $LiAlH_4$, H_2O; (ii) $NaNO_2$ + HCl; (iii) H_2O→ ?

(A) Benzamide ($C_6H_5CONH_2$)
(B) $C_6H_5CH_2N_2^+Cl^-$
(C) Benzyl chloride ($C_6H_5CH_2Cl$)
(D) Benzyl alcohol ($C_6H_5CH_2OH$)

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30. The order of energy absorbed which is responsible for the color of complexes
(i) $[Ni(H_2O)_2(en)_2]^{2+}$
(ii) $[Ni(H_2O)_4(en)]^{2+}$ and
(iii) $[Ni(en)_3]^{2+}$
is

(A) $[Ni(H_2O)_2(en)_2]^{2+} > [Ni(H_2O)_4(en)]^{2+} > [Ni(en)_3]^{2+}$
(B) $[Ni(en)_3]^{2+} > [Ni(H_2O)_4(en)]^{2+} > [Ni(H_2O)_2(en)_2]^{2+}$
(C) $[Ni(en)_3]^{2+} > [Ni(H_2O)_2(en)_2]^{2+} > [Ni(H_2O)_4(en)]^{2+}$
(D) $[Ni(H_2O)_4(en)]^{2+} > [Ni(H_2O)_2(en)_2]^{2+} > [Ni(en)_3]^{2+}$

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31. Compound X on reaction with O_3 followed by Zn/H_2O gives formaldehyde and 2-methyl propanal as products. The compound X is

(A) 3-Methylbut-1-ene
(B) 2-Methylbut-1-ene
(C) 2-Methylbut-2-ene
(D) Pent-2-ene

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32. $3O_2(g) \rightleftharpoons 2O_3(g)$
for the above reaction at 298 K, Kc is found to be 3.0×10^{-59}. If the concentration of O_2 at equilibrium is 0.040 M then concentration of O_3 in M is

(A) 4.38×10^{-32}
(B) 1.9×10^{-63}
(C) 2.4×10^{31}
(D) 1.2×10^{21}

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33. Which one of the following is not formed when acetone reacts with 2-pentanone in the presence of dilute NaOH followed by heating?

(A) $CH_3COCH{=}C(CH_3)_2$
(B) $CH_3CH_2COC(CH_3){=}C(CH_2CH_3)_2$
(C) $CH_3CH_2CH_2C(CH_3){=}CHCOCH_3$
(D) $(CH_3)_2C{=}C(CH_2CH_3)COCH_3$

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34. Match List - I with List - II.
List - I (Drug class): (a) Antacids (b) Antihistamines (c) Analgesics (d) Antimicrobials
List - II (Drug molecule): (i) Salvarsan (ii) Morphine (iii) Cimetidine (iv) Seldane
Choose the correct answer from the options given below :

(A) (a) - (iii), (b) - (ii), (c) - (iv), (d) - (i)
(B) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)
(C) (a) - (i), (b) - (iv), (c) - (ii), (d) - (iii)
(D) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

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35. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : In a particular point defect, an ionic solid is electrically neutral, even if few of its cations are missing from its unit cells.
Reason (R) : In an ionic solid, Frenkel defect arises due to dislocation of cation from its lattice site to interstitial site, maintaining overall electrical neutrality.
In the light of the above statements, choose the most appropriate answer from the options given below :

(A) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(C) (A) is correct but (R) is not correct
(D) (A) is not correct but (R) is correct

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36. Choose the correct statement:

(A) Diamond and graphite have two dimensional network.
(B) Diamond is covalent and graphite is ionic.
(C) Diamond is sp^3 hybridized and graphite is sp^2 hybridized
(D) Both diamond and graphite are used as dry lubricants.

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37. Identify the incorrect statement from the following

(A) Alkali metals react with water to form their hydroxides.

(B) The oxidation number of K in KO_2 is +4.

(C) Ionisation enthalpy of alkali metals decreases from top to bottom in the group.

(D) Lithium is the strongest reducing agent among the alkali metals.

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38. Which one is not correct mathematical equation for Dalton's Law of partial pressure? Here p = total pressure of gaseous mixture
where p_i = partial pressure of i^{th} gas
χ_i = mole fraction of i^{th} gas in gaseous mixture
p_i° = pressure of i^{th} gas in pure state

(A) $p = p_1 + p_2 + p_3$

(B) $p = n_1(RT/V) + n_2(RT/V) + n_3(RT/V)$

(C) $p_i = \chi_i p$

(D) $p_i = \chi_i p_i^\circ$

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39. Given below ae two statements
Statement I:
In the coagulation of a negative sol, the flocculating power of the three given ions is in the order $Al^{3+} > Ba^{2+} > Na^+$
Statement II:
In the coagulation of a positive sol, the flocculating power of the three given salts is in the order $NaCl > Na_2SO_4 > Na_3PO_4$
In the light of the above statements, choose the most appropriate answer from the options given below

(A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are incorrect.

(C) Statement I is correct but Statement II is incorrect.

(D) Statement I is incorrect but Statement II is correct.

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40. Match List - I with List - II
List - I: (a) Li (b) Na (c) KOH (d) Cs
List - II: (i) absorbent for carbon dioxide (ii) electrochemical cells (iii) coolant in fast breeder reactors (iv) photoelectric cell
Choose the correct answer from the options given below :

(A) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

(B) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

(C) (a) - (i), (b) - (iii), (c) - (iv), (d) - (ii)

(D) (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)

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41. Which statement regarding polymers is not correct?

(A) Elastomers have polymer chains held together by weak intermolecular forces

(B) Fibers possess high tensile strength

(C) Thermoplastic polymers are capable of repeatedly softening and hardening on heating and cooling respectively

(D) Thermosetting polymers are reusable

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42. A 10.0 L flask contains 64 g of oxygen at 27°C. (Assume O_2 gas is behaving ideally). The pressure inside the flask in bar is (Given R = 0.0831 L bar K^{-1} mol^{-1})

(A) 2.5
(B) 498.6
(C) 49.8
(D) 4.9

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43. The pollution due to oxides of sulphur gets enhanced due to the presence of:
(a) particulate matter (b) ozone (c) hydrocarbons (d) hydrogen peroxide
Choose the most appropriate answer from the options given below:

(A) (a), (d) only
(B) (a), (b), (d) only
(C) (b), (c), (d) only
(D) (a), (c), (d) only

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44. Copper crystallises in fcc unit cell with cell edge length of 3.608×10^{-8} cm. The density of copper is 8.92 g cm^{-3}. Calculate the atomic mass of copper.

(A) 63.1 u
(B) 31.55 u
(C) 60 u
(D) 65 u

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45. Match List - I with List - II.
List - I (Ores): (a) Haematite (b) Magnetite (c) Calamine (d) Kaolinite
List - II (Composition): (i) Fe_3O_4 (ii) $ZnCO_3$ (iii) Fe_2O_3 (iv) $[Al_2(OH)_4Si_2O_5]$
Choose the correct answer from the options given below:

(A) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
(B) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)
(C) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)
(D) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

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46. In the neutral or faintly alkaline medium, $KMnO_4$ oxidises iodide into iodate. The change in oxidation state of manganese in this reaction is form

(A) +7 to +4
(B) +6 to +4
(C) +7 to +3
(D) +6 to +5

Answer key and explanations

1. Answer: (A) Both (A) and (R) are correct and (R) is the correct explanation of (A).

Interhalogen compounds such as ICl are generally more reactive than the parent halogens (except F_2) because the polar I–Cl bond is weaker than the homonuclear I–I bond. The weaker bond is exactly why ICl reacts more readily, so both statements are true and the reason explains the assertion.

2. Answer: (D) Cycloheptatriene (C_7H_8, with one sp^3 CH_2 in the ring)

An aromatic species must be cyclic, planar and fully conjugated with (4n+2) π electrons. Cyclopentadienyl anion (6π), tropylium cation (6π) and cyclopropenyl cation (2π) all satisfy this. Cycloheptatriene has an sp^3 CH_2 group that breaks the cyclic conjugation, so it is not aromatic.

3. Answer: (A) ununennium

Using IUPAC digit roots 1 = un, 1 = un, 9 = enn and the suffix -ium, element 119 is un-un-enn-ium = ununennium. Unununnium corresponds to 111 and ununoctium to 118.

4. Answer: (A) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

MgH_2 is a saline (ionic) hydride; GeH_4 (group 14) has exactly enough electrons for normal bonds, so it is electron precise; B_2H_6 (group 13) is electron deficient; HF (group 17) carries lone pairs and is electron rich. This gives (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii).

5. Answer: (C) Enzymes are polysaccharides.

Almost all enzymes are globular proteins, not polysaccharides, so that statement is incorrect. Enzymes are indeed biocatalysts that lower activation energy and are highly specific for their substrate and reaction.

6. Answer: (D) diaquasilver(I) dicyanidoargentate(I)

The cation is $[Ag(H_2O)_2]^+$ (water neutral, so Ag is +1) and is named first: diaquasilver(I). The anion is $[Ag(CN)_2]^-$ (two CN^-, so Ag is +1) and takes the -ate ending with the Latin name: dicyanidoargentate(I). Silver is +1 in both, so names with silver(II) are wrong.

7. Answer: (B) high exchange enthalpy

Gd is $[Xe]4f^7 5d^1 6s^2$; after the third electron (the $5d^1$) is removed, Gd^{3+} has the half-filled $4f^7$ configuration. The large exchange energy stabilising $4f^7$ makes this removal easy, giving a low third ionisation enthalpy. Size or electronegativity would not lower it in this way.

8. Answer: (D) XeF_2

Lone pairs on the central atom: ClF_3 has 2, IF_5 has 1, SF_4 has 1 and XeF_2 has 3. XeF_2, with three lone pairs in the equatorial plane of a trigonal bipyramid, has the greatest number of lone pair–lone pair repulsions. IF_5 and SF_4 have a single lone pair and so no lone pair–lone pair repulsion.

9. Answer: (D) Both the Boron atoms are sp^2 hybridised.

In B_2H_6 each boron is sp^3 hybridised: two sp^3 orbitals form terminal 2c–2e B–H bonds and two take part in the two 3c–2e B–H–B bridge bonds. The four terminal H atoms and both B atoms are coplanar, with the bridging hydrogens above and below that plane. So the claim of sp^2 boron is the incorrect statement.

10. Answer: (A) Both Statement I and Statement II are correct

The polar C=O group gives aldehydes and ketones dipole–dipole association, so they boil higher than hydrocarbons of similar mass. They cannot form intermolecular hydrogen bonds with each other, so they boil lower than alcohols of similar mass. Both statements are correct.

11. Answer: (C) Enantiomers are superimposable mirror images on each other

Enantiomers are non-superimposable mirror images, so calling them superimposable is the incorrect statement. SN1 via a planar carbocation gives (ideally) a racemic mixture, SN2 backside attack inverts configuration, and a racemic mixture shows zero rotation because the two rotations cancel.

12. Answer: (A) Benzene, Cl_2, anhydrous $FeCl_3$

Electrophilic chlorination of benzene with Cl_2 and anhydrous $FeCl_3$ (Lewis acid) gives chlorobenzene. Phenol cannot be diazotised (diazotisation needs an $–NH_2$ group), benzene does not react with HCl, and heating aniline with HCl only gives anilinium chloride.

13. Answer: (D) The shapes of dxy, dyz and dzx orbitals are similar to each other; and dx^2-y^2 and dz^2 are similar to each other.

dxy, dyz and dzx have the same four-lobed shape, and dx^2-y^2 is also four-lobed, but dz^2 has two lobes along z with a doughnut ring in the xy-plane, so dx^2-y^2 and dz^2 are not similar in shape. The other statements are true: 5d orbitals are larger than 4d, shapes are the same across shells, and the five d orbitals are degenerate in a free atom.

14. Answer: (C) Aniline ($C_6H_5NH_2$)

Kjeldahl's method converts nitrogen to ammonium sulphate by digestion with conc. H_2SO_4, which fails for nitro and azo groups and for nitrogen in a ring such as pyridine. Aniline has an amino group that is converted completely, so its nitrogen can be estimated.

15. Answer: (C) Statement I is correct but Statement II is incorrect.

The electron-withdrawing $–NO_2$ group stabilises the phenoxide ion, so every nitrophenol is more acidic than phenol. The effect depends on position: o- and p-nitro groups act by –R and –I effects while m-nitro acts only by –I, so the three isomers have different pKa values. Statement I is correct and Statement II is incorrect.

16. Answer: (D) $2CuSO_4(aq) + 2Ag(s) \rightarrow 2Cu(s) + Ag_2SO_4(aq)$

A metal can displace another only if its reduction potential is lower. For Ag reducing Cu^{2+}: $E°cell = E°(Cu^{2+}/Cu) - E°(Ag^+/Ag) = 0.34 - 0.80 = -0.46$ V, so that reaction cannot occur. Zn (−0.76 V) reducing Cu^{2+} (+1.10 V), Fe (−0.44 V) reducing Cu^{2+} (+0.78 V) and Zn reducing Fe^{2+} (+0.32 V) all have positive E°cell.

17. Answer: (C) Statement I is correct but Statement II is incorrect.

Aliphatic diazonium salts are highly unstable and decompose at once to give N_2 and alcohols. Arenediazonium salts are stable only at low temperature (about 273–278 K) and decompose on warming, so they are not stable above 300 K. Statement I is correct and Statement II is incorrect.

18. Answer: (B) 500 g of solvent

Molality = moles of solute / kg of solvent, so mass of solvent = 0.5 mol / 1 mol kg^{-1} = 0.5 kg = 500 g. Molality is defined by mass of solvent, not volume, so 500 mL is the trap; 1000 g would hold 1 mol of solute.

19. Answer: (A) $RCOO^-Mg^+X$

The carbanion-like R of the Grignard reagent adds to the carbon of CO_2, giving the halomagnesium carboxylate $RCOO^-Mg^+X$. Acid hydrolysis of this salt gives RCOOH. $R_3CO^-Mg^+X$ is the type of intermediate formed from ketones and gives tertiary alcohols, not acids.

20. Answer: (A) Yes, because E°cell = + 0.287 V

$E°(Mn^{2+}/MnO_4^-) = -1.510$ V is an oxidation potential, so the reduction potential of MnO_4^-/Mn^{2+} is +1.510 V. With MnO_4^- reduced at the cathode and water oxidised to O_2 at the anode, E°cell = 1.510 − 1.223 = +0.287 V. A positive value means the reaction is feasible, so permanganate can liberate O_2; adding the two values (2.733 V) is the trap.

21. Answer: (B) 1.32 g

Moles of HCl = 0.050 L × 0.5 M = 0.025 mol, so $CaCO_3$ needed = 0.0125 mol × 100 g mol^{-1} = 1.25 g of pure $CaCO_3$. Since the sample is only 95% pure, mass required = 1.25/0.95 = 1.3158 ≈ 1.32 g. 1.25 g ignores the purity correction.

22. Answer: (A) 5.57

This is an acidic buffer: pH = pKa + log([salt]/[acid]). Equal volumes are mixed, so the ratio is 0.10/0.01 = 10 and pH = 4.57 + log 10 = 5.57. 4.57 would be the answer only for equal concentrations of salt and acid.

23. Answer: (D) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

Carbonyl compounds add HCN to give cyanohydrins, react with alcohols (dry HCl) to give acetals, condense with primary amines RNH_2 to give Schiff's bases (imines), and with hydroxylamine NH_2OH to give oximes. So (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i).

24. Answer: (D) O_2^+ ion is diamagnetic

O_2^+ has 15 electrons; its configuration ends in π^*2p^1, so it has one unpaired electron and is paramagnetic, making the diamagnetic claim incorrect. The bond orders 2.5, 2, 1.5, 1 are correct, C_2 has $\pi 2p_x^2\ \pi 2p_y^2$ (four electrons in two degenerate π orbitals), and H_2^+ has a single electron.

25. Answer: (C) Statement I is correct but Statement II is incorrect

Lucas reagent (conc. HCl + $ZnCl_2$) distinguishes alcohols by how fast they form insoluble alkyl chlorides. Tertiary alcohols react fastest (immediate turbidity) through a stable carbocation, while primary alcohols do not give turbidity at room temperature. Statement I is correct and Statement II is incorrect.

26. Answer: (A) 158.7 pm

Bohr radius $r_n = a_0 n^2/Z$. For He^+ (n = 2, Z = 2): 105.8 = a_0 × 4/2, so a_0 = 52.9 pm. For Li^{2+} (n = 3, Z = 3): r = 52.9 × 9/3 = 158.7 pm. The same number in Å is wrong by a factor of 100 in units.

27. Answer: (B) 0.9212

For first order, k = (2.303/t) log($[A]_0/[A]$) = (2.303/5 min) × log(0.1/0.001) = 0.4606 × 2 = 0.9212 min^{-1}. 0.4606 forgets that log 100 = 2.

28. Answer: (A) 1-bromo-5-chloro-4-methylhexan-3-ol

The parent chain has six carbons and the –OH (principal group) must get the lowest locant, so numbering starts at the CH_2Br end: Br on C1, OH on C3, CH_3 on C4, Cl on C5. Substituent prefixes are written alphabetically (bromo, chloro, methyl), giving 1-bromo-5-chloro-4-methylhexan-3-ol. Placing methyl before chloro breaks the alphabetical rule, and numbering from the other end gives the –OH the higher locant 4.

29. Answer: (D) Benzyl alcohol ($C_6H_5CH_2OH$)

$LiAlH_4$ reduces benzonitrile to benzylamine, $C_6H_5CH_2NH_2$. Nitrous acid converts this primary aliphatic-type amine into an unstable benzyldiazonium ion, which loses N_2 in water to give benzyl alcohol. The benzyldiazonium salt is not isolable, unlike arenediazonium salts.

30. Answer: (C) $[Ni(en)_3]^{2+} > [Ni(H_2O)_2(en)_2]^{2+} > [Ni(H_2O)_4(en)]^{2+}$

en is a stronger field ligand than H_2O, so the crystal field splitting Δo (and hence the energy absorbed) increases with the number of en ligands. $[Ni(en)_3]^{2+}$ (three en) > $[Ni(H_2O)_2(en)_2]^{2+}$ (two en) > $[Ni(H_2O)_4(en)]^{2+}$ (one en). The reverse order confuses absorbed energy with the wavelength absorbed.

31. Answer: (A) 3-Methylbut-1-ene

Joining HCHO ($CH_2=$) and $(CH_3)_2CH–CHO$ ($=CH–CH(CH_3)_2$) across a C=C gives $CH_2=CH–CH(CH_3)_2$, i.e. 3-methylbut-1-ene. 2-Methylbut-1-ene would give HCHO and butan-2-one, and 2-methylbut-2-ene gives acetone and acetaldehyde.

32. Answer: (A) 4.38×10^{-32}

$K_c = [O_3]^2/[O_2]^3$, so $[O_3]^2 = 3.0 \times 10^{-59} \times (0.040)^3 = 3.0 \times 10^{-59} \times 6.4 \times 10^{-5} = 1.92 \times 10^{-63}$. Taking the square root, $[O_3] = 4.38 \times 10^{-32}$ M. 1.9×10^{-63} is $[O_3]^2$ without the square root.

33. Answer: (B) $CH_3CH_2COC(CH_3)=C(CH_2CH_3)_2$

Aldol condensation then dehydration: acetone with itself gives $(CH_3)_2C=CHCOCH_3$ (mesityl oxide); the acetone enolate attacking 2-pentanone gives $CH_3COCH=C(CH_3)CH_2CH_2CH_3$; the C-3 enolate of 2-pentanone attacking acetone gives $(CH_3)_2C=C(C_2H_5)COCH_3$. $CH_3CH_2COC(CH_3)=C(C_2H_5)_2$ contains an ethyl ketone unit that would need 3-pentanone, so it cannot form from these reactants.

34. Answer: (B) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

Cimetidine is an antacid (H_2-receptor blocker), Seldane (terfenadine) is an antihistamine, morphine is a narcotic analgesic, and Salvarsan (arsphenamine) is an antimicrobial used against syphilis. So (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i).

35. Answer: (B) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

The assertion describes a Schottky defect, where equal numbers of cations and anions are missing, so the solid stays neutral even though cations are absent. The reason correctly describes a Frenkel defect (a cation moved to an interstitial site). Both are true, but the Frenkel defect does not explain the Schottky case where ions are actually missing.

36. Answer: (C) Diamond is sp^3 hybridized and graphite is sp^2 hybridized

In diamond each carbon is sp^3 bonded to four others in a three-dimensional network; in graphite each carbon is sp^2 bonded within flat hexagonal layers. Both are covalent, only graphite is layered (two-dimensional), and only graphite is a dry lubricant.

37. Answer: (B) The oxidation number of K in KO_2 is +4.

KO_2 is potassium superoxide, containing the O_2^- ion, so K is +1, not +4. Alkali metals do give hydroxides with water, their ionisation enthalpy decreases down the group, and Li is the strongest reducing agent in aqueous solution (most negative E°) due to its high hydration enthalpy.

38. Answer: (D) $p_i = \chi_i p_i^\circ$

Dalton's law states $p = p_1 + p_2 + p_3$, and each partial pressure is $n_iRT/V = \chi_i p$. The relation $p_i = \chi_i p_i^\circ$ is Raoult's law for vapour pressure over a solution, not Dalton's law.

39. Answer: (C) Statement I is correct but Statement II is incorrect.

By the Hardy–Schulze rule, coagulating power rises with the charge of the oppositely charged ion. For a negative sol the cations rank $Al^{3+} > Ba^{2+} > Na^+$, so Statement I is correct. For a positive sol the anions rank $PO_4^{3-} > SO_4^{2-} > Cl^-$, so the order should be $Na_3PO_4 > Na_2SO_4 > NaCl$ and Statement II is incorrect.

40. Answer: (D) (a) - (ii), (b) - (iii), (c) - (i), (d) - (iv)

Lithium is used in electrochemical cells (batteries), liquid sodium as a coolant in fast breeder reactors, KOH as an absorbent for CO_2, and caesium (lowest ionisation enthalpy) in photoelectric cells. So (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv).

41. Answer: (D) Thermosetting polymers are reusable

Thermosetting polymers form extensive cross-links on heating and become permanently hard and infusible, so they cannot be remoulded or reused. Elastomers do have weak forces between chains, fibres have high tensile strength, and thermoplastics soften and harden repeatedly.

42. Answer: (D) 4.9

n = 64/32 = 2 mol, T = 300 K. $p = nRT/V = 2 \times 0.0831 \times 300 / 10.0 = 4.986$ bar, matching 4.9 bar. 49.8 and 498.6 result from slips in the volume or decimal place.

43. Answer: (B) (a), (b), (d) only

The oxidation of SO_2 to SO_3, which makes sulphur oxide pollution worse (acid rain), is catalysed by particulate matter and promoted by oxidants such as ozone and hydrogen peroxide. Hydrocarbons are not listed among these promoters, so the answer is particulate matter, ozone and hydrogen peroxide.

44. Answer: (A) 63.1 u

For fcc Z = 4, and $M = \rho a^3 N_A/Z$. $a^3 = (3.608 \times 10^{-8})^3 = 4.697 \times 10^{-23}$ cm³; $M = 8.92 \times 4.697 \times 10^{-23} \times 6.022 \times 10^{23} / 4 = 252.3/4 = 63.1$ g mol⁻¹. Using Z = 8 by mistake would give half this value, 31.55.

45. Answer: (B) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

Haematite is Fe_2O_3, magnetite is Fe_3O_4, calamine is $ZnCO_3$ and kaolinite is the clay $[Al_2(OH)_4Si_2O_5]$. So (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv); swapping the two iron oxides is the main trap.

46. Answer: (A) +7 to +4

In neutral or faintly alkaline solution: $2MnO_4^- + I^- + H_2O \rightarrow 2MnO_2 + IO_3^- + 2OH^-$. Mn goes from +7 in MnO_4^- to +4 in MnO_2 (a 3-electron change). +6 is the state in manganate, not permanganate.

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