NEET 2024 Re-exam — Chemistry Question Paper with Solutions

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

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1. The correct decreasing order of atomic radii (pm) of Li, Be, B and C is

(A) Be > Li > B > C
(B) Li > Be > B > C
(C) C > B > Be > Li
(D) Li > C > Be > B

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2. Following data is for a reaction between reactants A and B :

Rate (mol L^{-1} s^{-1}) | [A] | [B]
2×10^{-3} | 0.1 M | 0.1 M
4×10^{-3} | 0.2 M | 0.1 M
1.6×10^{-2} | 0.2 M | 0.2 M

The order of the reaction with respect to A and B, respectively, are

(A) 1, 0
(B) 0, 1
(C) 1, 2
(D) 2, 1

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3. Baeyer's reagent is :

(A) Acidic potassium permanganate solution
(B) Acidic potassium dichromate solution
(C) Cold, dilute, aqueous solution of potassium permanganate
(D) Hot, concentrated solution of potassium permanganate

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4. Which of the following molecules has "NON ZERO" dipole moment value?

(A) CCl_4
(B) HI
(C) CO_2
(D) BF_3

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5. Which indicator is used in the titration of sodium hydroxide against oxalic acid and what is the colour change at the end point?

(A) Phenolphthalein, pink to yellow
(B) Alkaline $KMnO_4$, colourless to pink
(C) Phenolphthalein, colourless to pink
(D) Methyl orange, yellow to pinkish red colour

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6. Match List I with List II :

List - I (Atom/Molecule): (A) Nitrogen atom (B) Fluorine molecule (C) Oxygen molecule (D) Xenon atom
List - II (Property): (I) Paramagnetic (II) Most reactive element in group 18 (III) Element with highest ionisation enthalpy in group 15 (IV) Strongest oxidising agent
Identify the correct answer from the options given below :

(A) A-III, B-I, C-IV, D-II
(B) A-I, B-IV, C-III, D-II
(C) A-II, B-IV, C-I, D-III
(D) A-III, B-IV, C-I, D-II

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7. From the following select the one which is not an example of corrosion.

(A) Rusting of iron object
(B) Production of hydrogen by electrolysis of water
(C) Tarnishing of silver
(D) Development of green coating on copper and bronze ornaments

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8. Which of the following pairs of ions will have same spin only magnetic moment values within the pair?

A. Zn^{2+}, Ti^{2+}
B. Cr^{2+}, Fe^{2+}
C. Ti^{3+}, Cu^{2+}
D. V^{2+}, Cu^{+}

Choose the correct answer from the options given below :

(A) C and D only
(B) A and D only
(C) A and B only
(D) B and C only

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9. At a given temperature and pressure, the equilibrium constant values for the equilibria are given below:

$3A_2 + B_2 \rightleftharpoons 2A_3B$, K_1
$A_3B \rightleftharpoons (3/2)A_2 + (1/2)B_2$, K_2

The relation between K_1 and K_2 is :

(A) $K_1^2 = 2K_2$
(B) $K_2 = K_1/2$
(C) $K_1 = 1/\sqrt{K_2}$
(D) $K_2 = 1/\sqrt{K_1}$

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10. Identify the incorrect statement about PCl_5.

(A) PCl_5 possesses two different Cl–P–Cl bond angles
(B) All five P–Cl bonds are identical in length
(C) PCl_5 exhibits sp^3d hybridisation
(D) PCl_5 consists of five P–Cl (sigma) bonds

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11. Choose the correct statement for the work done in the expansion and heat absorbed or released when 5 litres of an ideal gas at 10 atmospheric pressure isothermally expands into vacuum until volume is 15 litres :

(A) Both the heat and work done will be greater than zero
(B) Heat absorbed will be less than zero and work done will be positive
(C) Work done will be zero and heat will also be zero
(D) Work done will be greater than zero and heat will remain zero

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12. Which of the following set of ions act as oxidising agents?

(A) Ce^{4+} and Tb^{4+}
(B) La^{3+} and Lu^{3+}
(C) Eu^{2+} and Yb^{2+}
(D) Eu^{2+} and Tb^{4+}

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13. Select the incorrect reaction among the following :

(A) $CH_3COCl \xrightarrow{(H_2O,\ \Delta)} CH_3COOH$

(B) $C_6H_5CONH_2 \xrightarrow{(i)\ LiAlH_4,\ (ii)\ H_2O} C_6H_5COOH$

(C) $CH_3CH_2OH \xrightarrow{(i)\ KMnO_4/OH^-,\ (ii)\ H_3O^+} CH_3COOH$

(D) $CH_3CH_2CH_2OH \xrightarrow{(CrO_3-H_2SO_4)} CH_3CH_2COOH$

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14. The UV-visible absorption bands in the spectra of lanthanoid ions are 'X', probably because of the excitation of electrons involving 'Y'. The 'X' and 'Y', respectively, are :

(A) Broad and f orbitals

(B) Narrow and f orbitals

(C) Broad and d and f orbitals

(D) Narrow and d and f orbitals

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15. Ethylene diaminetetraacetate ion is a/an:

(A) hexadentate ligand

(B) ambidentate ligand

(C) monodentate ligand

(D) bidentate ligand

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16. The amount of glucose required to prepare 250 mL of M/20 aqueous solution is : (Molar mass of glucose : 180 g mol^{-1})

(A) 2.25 g

(B) 4.5 g

(C) 0.44 g

(D) 1.125 g

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17. Identify the incorrect statement from the following :

(A) The acidic strength of HX (X = F, Cl, Br and I) follows the order: HF > HCl > HBr > HI.

(B) Fluorine exhibits −1 oxidation state whereas other halogens exhibit +1, +3, +5 and +7 oxidation states also.

(C) The enthalpy of dissociation of F_2 is smaller than that of Cl_2.

(D) Fluorine is stronger oxidising agent than chlorine.

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18. For the reaction in equilibrium

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, $\Delta H = -Q$

Reaction is favoured in forward direction by:

(A) use of catalyst

(B) decreasing concentration of N_2

(C) low pressure, high temperature and high concentration of ammonia

(D) high pressure, low temperature and higher concentration of H_2

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19. The major product D formed in the following reaction sequence is :

$CH_3OH \xrightarrow{SOCl_2} A \xrightarrow{KCN,\ aq.\ EtOH} B \xrightarrow{Na(Hg),\ EtOH} C \xrightarrow{(i)\ NaNO_2 + HCl,\ (ii)\ H_2O} D$ (major)

(A) CH_3CHO

(B) CH_3CONH_2

(C) CH_3CH_2OH

(D) CH_3CH_2Cl

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20. Match List I with List II:

List - I (Block/group in periodic table): (A) Lanthanoid (B) d-block element (C) p-block element (D) s-block element

List - II (Element): (I) Ce (II) As (III) Cs (IV) Mn

Choose the correct answer from the options given below:

(A) A-I, B-II, C-IV, D-III
(B) A-I, B-IV, C-III, D-II
(C) A-I, B-IV, C-II, D-III
(D) A-IV, B-I, C-II, D-III

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21. Which of the following is not an ambidentate ligand?

(A) $C_2O_4^{2-}$
(B) SCN^-
(C) NO_2^-
(D) CN^-

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22. The quantum numbers of four electrons are given below :

I. n = 4; l = 2; m_l = −2; s = −1/2

II. n = 3; l = 2; m_l = 1; s = +1/2

III. n = 4; l = 1; m_l = 0; s = +1/2

IV. n = 3; l = 1; m_l = −1; s = +1/2

The correct decreasing order of energy of these electrons is

(A) IV > II > III > I
(B) I > III > II > IV
(C) III > I > II > IV
(D) I > II > III > IV

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23. The major product C in the below mentioned reaction is:

$CH_3CH_2CH_2Br$ —alc. KOH, Δ→ A —HBr→ B —aq. KOH, Δ→ C

(A) Propan-1-ol
(B) Propan-2-ol
(C) Propane
(D) Propyne

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24. The compound that does not undergo Friedel-Crafts alkylation reaction but gives a positive carbylamine test is :

(A) Aniline
(B) Pyridine
(C) N-methylaniline
(D) Triethylamine

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25. For an endothermic reaction:

(A) q_p is negative.

(B) Δ_rH is positive.

(C) Δ_rH is negative.

(D) q_p is positive.

Choose the correct answer from the options given below:

(A) B and D
(B) C and D
(C) A and B
(D) A and C

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26. 1.0 g of H_2 has same number of molecules as in:

(A) 14 g of N_2
(B) 18 g of H_2O
(C) 16 g of CO
(D) 28 g of N_2

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27. A steam volatile organic compound which is immiscible with water has a boiling point of 250°C. During steam distillation, a mixture of this organic compound and water will boil :

(A) above 100°C but below 250°C
(B) above 250°C
(C) at 250°C
(D) close to but below 100°C

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28. Given below are two statements :
Statement I : Glycogen is similar to amylose in its structure.
Statement II : Glycogen is found in yeast and fungi also.
In the light of the above statements, choose the correct answer from the options given below :

(A) Statement I is true but Statement II is false.
(B) Statement I is false but Statement II is true.
(C) Both Statement I and Statement II are true.
(D) Both Statement I and Statement II are false.

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29. The oxidation states not shown by Mn in given reaction are :
$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
A. +6
B. +2
C. +4
D. +7
E. +3
Choose the most appropriate answer from the options given below :

(A) D and E only
(B) B and D only
(C) A and B only
(D) B and E only

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30. Given below are two statements:
Statement I: The Balmer spectral line for H atom with lowest energy is located at $(5/36)R_H$ cm^{-1}.
(R_H = Rydberg constant)
Statement II: When the temperature of blackbody increases, the maxima of the curve (intensity and wavelength) shifts to shorter wavelength.
In the light of the above statements, choose the correct answer from the options given below:

(A) Statement I is true but Statement II is false
(B) Statement I is false but Statement II is true
(C) Both Statement I and Statement II are true
(D) Both Statement I and Statement II are false

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31. Identify D in the following sequence of reactions:

CH_3CH_2OH —P + I_2→ A —Mg, dry ether→ B —HCHO→ C —H_2O→ D (major)

(A) n-propyl alcohol
(B) isopropyl alcohol
(C) propanal
(D) propionic acid

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32. Identify the incorrect statement.

(A) PEt_3 and $AsPh_3$ as ligands can form dπ–dπ bond with transition metals
(B) The N–N single bond is as strong as the P–P single bond
(C) Nitrogen has unique ability to form pπ–pπ multiple bonds with nitrogen, carbon and oxygen
(D) Nitrogen cannot form dπ–pπ bond as other heavier elements of its group

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33. Match List-I with List-II :

List - I (Test/reagent): (A) Lake Test (B) Nessler's Reagent (C) Potassium sulphocyanide (D) Brown Ring Test

List - II (Radical identified): (I) NO_3^- (II) Fe^{3+} (III) Al^{3+} (IV) NH_4^+

Choose the correct answer from the options given below :

(A) A-IV, B-II, C-III, D-I
(B) A-II, B-IV, C-III, D-I
(C) A-II, B-III, C-IV, D-I
(D) A-III, B-IV, C-II, D-I

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34. Match List-I with List-II:

List - I (Molecule): (A) HCl (B) N_2 (C) H_2 (D) O_2

List - II (Bond enthalpy (kJ mol^{-1})): (I) 435.8 (II) 498 (III) 946.0 (IV) 431.0

Choose the correct answer from the options given below:

(A) A-III, B-IV, C-I, D-II
(B) A-IV, B-I, C-III, D-II
(C) A-IV, B-III, C-II, D-I
(D) A-IV, B-III, C-I, D-II

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35. The standard cell potential of the following cell Zn | Zn^{2+}(aq) | Fe^{2+}(aq) | Fe is 0.32 V. Calculate the standard Gibbs energy change for the reaction:

Zn(s) + Fe^{2+}(aq) → Zn^{2+}(aq) + Fe(s)

(Given : 1 F = 96487 C)

(A) −61.75 kJ mol^{-1}
(B) +5.006 kJ mol^{-1}
(C) −5.006 kJ mol^{-1}
(D) +61.75 kJ mol^{-1}

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36. Match List I with List II:

List - I (Solid salt treated with dil. H_2SO_4): (A) effervescence of colourless gas (B) gas with smell of rotten egg (C) gas with pungent smell (D) brown fumes

List - II (Anion detected): (I) NO_2^- (II) CO_3^{2-} (III) S^{2-} (IV) SO_3^{2-}

Choose the correct answer from the options given below:

(A) A-II, B-III, C-IV, D-I
(B) A-IV, B-III, C-II, D-I
(C) A-I, B-II, C-III, D-IV
(D) A-II, B-III, C-I, D-IV

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37. The ratio of solubility of AgCl in 0.1 M KCl solution to the solubility of AgCl in water is:
(Given : Solubility product of AgCl = 10^{-10})

(A) 10^{-4}
(B) 10^{-6}
(C) 10^{-9}
(D) 10^{-5}

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38. On complete combustion, 0.3 g of an organic compound gave 0.2 g of CO_2 and 0.1 g of H_2O. The percentage composition of carbon and hydrogen in the compound, respectively is:

(A) 4.07% and 15.02%
(B) 18.18% and 3.70%
(C) 15.02% and 4.07%
(D) 3.70% and 18.18%

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39. The following reaction method
$C_6H_5CH_3 + X_2 \xrightarrow{Fe,\ dark} o\text{-}XC_6H_4CH_3 + p\text{-}XC_6H_4CH_3$
is not suitable for the preparation of the corresponding haloarene products, due to high reactivity of halogen, when X is :

(A) F
(B) I
(C) Cl
(D) Br

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40. The alkane that can be oxidized to the corresponding alcohol by $KMnO_4$ as per the equation
$R_1R_2R_3C\text{–}H \xrightarrow{KMnO_4} R_1R_2R_3C\text{–}OH$
is, when :

(A) $R_1 = H$; $R_2 = H$; $R_3 = H$
(B) $R_1 = CH_3$; $R_2 = CH_3$; $R_3 = CH_3$
(C) $R_1 = CH_3$; $R_2 = H$; $R_3 = H$
(D) $R_1 = CH_3$; $R_2 = CH_3$; $R_3 = H$

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41. For the following reaction at 300 K
$A_2(g) + 3B_2(g) \rightarrow 2AB_3(g)$
the enthalpy change is +15 kJ, then the internal energy change is :

(A) 19988.4 J
(B) 200 J
(C) 1999 J
(D) 1.9988 kJ

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42. Rate constants of a reaction at 500 K and 700 K are 0.04 s^{-1} and 0.14 s^{-1}, respectively; then, activation energy of the reaction is :
(Given: log 3.5 = 0.5441, R = 8.31 J K^{-1} mol^{-1})

(A) 182310 J
(B) 18500 J
(C) 18219 J
(D) 18030 J

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43. Mass of glucose ($C_6H_{12}O_6$) required to be dissolved to prepare one litre of its solution which is isotonic with 15 g L^{-1} solution of urea (NH_2CONH_2) is (Given: Molar mass in g mol^{-1} C : 12, H : 1, O : 16, N : 14)

(A) 55 g
(B) 15 g
(C) 30 g
(D) 45 g

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44. $[Mn_2(CO)_{10}]$ and $[Co_2(CO)_8]$ structures have

A. Metal-Metal linkage
B. Terminal CO groups
C. Bridging CO groups
D. Metal in zero oxidation state
Choose the correct answer from the options given below

(A) Only A, B, C
(B) Only B, C, D
(C) Only A, C, D
(D) Only A, B, D

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45. Methyl group attached to a positively charged carbon atom stabilizes the carbocation due to

(A) –I inductive effect
(B) electromeric effect
(C) hyperconjugation
(D) mesomeric effect

Answer key and explanations

1. Answer: (B) Li > Be > B > C

Li, Be, B and C lie in the same period, and atomic radius falls across a period as nuclear charge rises while electrons enter the same shell. So the order is Li (152 pm) > Be (111 pm) > B (88 pm) > C (77 pm). Orders that put carbon or beryllium first reverse this trend.

2. Answer: (C) 1, 2

Runs 1 and 2: [A] doubles at fixed [B] and the rate goes from 2×10^{-3} to 4×10^{-3} ($\times 2 = 2^1$), so the order in A is 1. Runs 2 and 3: [B] doubles at fixed [A] and the rate goes from 4×10^{-3} to 1.6×10^{-2} ($\times 4 = 2^2$), so the order in B is 2. Reading the second change as a simple doubling would wrongly give order 1 in B.

3. Answer: (C) Cold, dilute, aqueous solution of potassium permanganate

Baeyer's reagent is cold, dilute, aqueous (slightly alkaline) $KMnO_4$; its purple colour disappears as it converts an alkene into a vicinal diol, which is the test for unsaturation. Acidic or hot concentrated permanganate cleaves the C=C bond instead, so those are not Baeyer's reagent.

4. Answer: (B) HI

HI is a heteronuclear diatomic molecule with an electronegativity difference between H and I, so it has a net dipole moment. CCl_4 (tetrahedral), CO_2 (linear) and BF_3 (trigonal planar) have polar bonds, but their bond dipoles cancel by symmetry, giving zero net dipole moment.

5. Answer: (C) Phenolphthalein, colourless to pink

Oxalic acid is a weak acid titrated with a strong base, so the end point is in the basic range and phenolphthalein is used. With the acid in the flask and NaOH from the burette, the solution goes from colourless to pink at the end point. Methyl orange changes in the acidic range and is unsuitable for a weak acid-strong base titration.

6. Answer: (D) A-III, B-IV, C-I, D-II

Nitrogen, the smallest atom of group 15 with a stable half-filled 2p shell, has the highest ionisation enthalpy in that group. F_2 is the strongest oxidising agent. O_2 has two unpaired electrons in π* orbitals (MO theory), so it is paramagnetic. Among the stable noble gases xenon, with the lowest ionisation enthalpy, forms the most compounds and is taken as the most reactive. Matching O_2 with 'strongest oxidising agent' confuses it with F_2.

7. Answer: (B) Production of hydrogen by electrolysis of water

Corrosion is the slow, unwanted attack of a metal by its surroundings (air, moisture, gases), as in rusting of iron, tarnishing of silver by sulphur compounds and the green basic carbonate coating on copper and bronze. Electrolysis of water to make hydrogen is a deliberate, current-driven decomposition of water, not attack on a metal, so it is not corrosion.

8. Answer: (D) B and C only

Count unpaired electrons, since $\mu = \sqrt{(n(n+2))}$ BM. Zn^{2+} $3d^{10}$ (0) and Ti^{2+} $3d^2$ (2): different. Cr^{2+} $3d^4$ (4) and Fe^{2+} $3d^6$ (4): both 4.90 BM. Ti^{3+} $3d^1$ (1) and Cu^{2+} $3d^9$ (1): both 1.73 BM. V^{2+} $3d^3$ (3) and Cu^{+} $3d^{10}$ (0): different. So only the Cr^{2+}/Fe^{2+} and Ti^{3+}/Cu^{2+} pairs match.

9. Answer: (D) $K_2 = 1/\sqrt{K_1}$

The second reaction is the first one reversed and multiplied by 1/2. Reversing gives the constant $1/K_1$, and halving the coefficients takes its square root, so $K_2 = (1/K_1)^{(1/2)} = 1/\sqrt{K_1}$. Writing $K_1 = 1/\sqrt{K_2}$ applies the square root to the wrong constant (the correct inverse is $K_1 = 1/K_2^2$).

10. Answer: (B) All five P–Cl bonds are identical in length

PCl_5 is trigonal bipyramidal (sp^3d) with five P–Cl σ bonds. The two axial bonds suffer more repulsion from the three equatorial bond pairs and are longer (about 240 pm) than the equatorial bonds (about 202 pm), so the five bonds are not all the same length. The bond angles are 120° (equatorial–equatorial) and 90° (axial–equatorial), so 'two different angles' is correct.

11. Answer: (C) Work done will be zero and heat will also be zero

Expansion into vacuum is free expansion: the external pressure is zero, so $w = -p_{ext}\,\Delta V = 0$. For an ideal gas at constant temperature $\Delta U = 0$, so $q = \Delta U - w = 0$ too. The initial 10 atm and the 5 L to 15 L change are red herrings; no work is done against a vacuum.

12. Answer: (A) Ce^{4+} and Tb^{4+}

Lanthanoids are most stable in the +3 state. Ce^{4+} ($4f^0$) and Tb^{4+} ($4f^7$) readily gain an electron to return to +3, so both are oxidising agents. Eu^{2+} and Yb^{2+} readily lose an electron to reach +3, so they are reducing agents, and La^{3+}/Lu^{3+} are already in the stable +3 state.

13. Answer: (B) $C_6H_5CONH_2$ —(i) $LiAlH_4$, (ii) H_2O→ C_6H_5COOH

$LiAlH_4$ reduces an amide C=O to CH_2, so benzamide gives benzylamine ($C_6H_5CH_2NH_2$), not benzoic acid. Acid chlorides hydrolyse to carboxylic acids, and primary alcohols are oxidised to the acids with the same carbon count by alkaline $KMnO_4$ or by Jones reagent (CrO_3–H_2SO_4), so those reactions are correct.

14. Answer: (B) Narrow and f orbitals

Lanthanoid ions are coloured because of f–f transitions. The 4f orbitals are deeply buried and shielded from the ligands by the 5s and 5p electrons, so the absorption bands are very narrow, almost line-like. Broad bands are typical of d–d transitions in transition-metal ions, whose d orbitals interact strongly with the ligands.

15. Answer: (A) hexadentate ligand

$EDTA^{4-}$ binds a metal through two nitrogen atoms and four carboxylate oxygen atoms, six donor sites in all, so it is hexadentate. An ambidentate ligand has two different donor atoms but uses only one at a time (like SCN^-), which is not how EDTA behaves.

16. Answer: (A) 2.25 g

Moles needed = $M \times V = (1/20\ \text{mol L}^{-1}) \times 0.250\ \text{L} = 0.0125$ mol. Mass = $0.0125 \times 180 = 2.25$ g. Using 500 mL or 125 mL by mistake would give 4.5 g or 1.125 g.

17. Answer: (A) The acidic strength of HX (X = F, Cl, Br and I) follows the order: HF > HCl > HBr > HI.

The acid strength of the hydrogen halides increases down the group, HF < HCl < HBr < HI, because the H–X bond becomes longer and weaker. So the order given with HF strongest is reversed and incorrect. The F–F bond is weaker than Cl–Cl because of lone-pair repulsion in the small F_2 molecule, fluorine shows only −1, and F_2 is the stronger oxidant, so those statements are correct.

18. Answer: (D) high pressure, low temperature and higher concentration of H_2

By Le Chatelier's principle: the forward reaction lowers the number of gas moles (4 → 2), so high pressure helps; it is exothermic, so low temperature helps; and adding the reactant H_2 shifts it forward. A catalyst only speeds up reaching equilibrium without shifting it, and removing N_2 or adding NH_3 pushes the reaction backward.

19. Answer: (C) CH_3CH_2OH

$SOCl_2$ converts methanol to CH_3Cl, which is A; KCN gives CH_3CN, which is B; and Na(Hg)/ethanol reduces the nitrile to ethylamine $CH_3CH_2NH_2$, which is C. Nitrous acid turns the primary aliphatic amine into an unstable diazonium salt that loses N_2 and reacts with water to give ethanol, which is D. Reduction adds one CH_2 to the chain, so it is not stopped at acetaldehyde or acetamide.

20. Answer: (C) A-I, B-IV, C-II, D-III

Cerium (Z = 58) is a lanthanoid, manganese (Z = 25) is a 3d transition element, arsenic (group 15) is a p-block element and caesium (group 1) is an s-block alkali metal. The usual trap is confusing Cs (caesium, s-block) with Ce (cerium, lanthanoid).

21. Answer: (A) $C_2O_4^{2-}$

An ambidentate ligand can bind through either of two different donor atoms: SCN^- (S or N), NO_2^- (N or O) and CN^- (C or N). Oxalate binds through two oxygen atoms at the same time, so it is a bidentate chelating ligand, not ambidentate.

22. Answer: (B) I > III > II > IV

Use the (n + l) rule: I is 4d (n + l = 6), II is 3d (5), III is 4p (5) and IV is 3p (4). For II and III with equal n + l, the one with larger n (4p) is higher in energy. So the order is 4d > 4p > 3d > 3p, i.e. I > III > II > IV. Putting 3d above 4p ignores the tie-break rule for equal n + l.

23. Answer: (B) Propan-2-ol

Alcoholic KOH dehydrohalogenates 1-bromopropane to propene, which is A. HBr adds by Markovnikov's rule (no peroxide) to give 2-bromopropane, which is B, and aqueous KOH substitutes Br by OH to give propan-2-ol, which is C. Propan-1-ol would need anti-Markovnikov addition, which is not the case here.

24. Answer: (A) Aniline

The carbylamine (isocyanide) test is given only by primary amines, and aniline is a primary aromatic amine. Aniline does not undergo Friedel-Crafts reactions because its basic NH_2 group forms a salt with the $AlCl_3$ catalyst, which deactivates the ring. N-methylaniline is secondary, and pyridine and triethylamine are tertiary bases, so they give no carbylamine test.

25. Answer: (A) B and D

An endothermic reaction absorbs heat from the surroundings. At constant pressure the heat absorbed is $q_p = \Delta_r H$, so both are positive. A negative $\Delta_r H$ or q_p describes an exothermic reaction.

26. Answer: (A) 14 g of N_2

1.0 g H_2 = 1.0/2 = 0.5 mol. 14 g N_2 = 14/28 = 0.5 mol, so it has the same number of molecules (0.5 N_a). 18 g H_2O and 28 g N_2 are 1 mol each, and 16 g CO is 16/28 ≈ 0.57 mol.

27. Answer: (D) close to but below 100°C

For immiscible liquids each component exerts its own vapour pressure, and the mixture boils when p(water) + p(organic) equals atmospheric pressure. This happens below the boiling point of the more volatile component, water, and since the high-boiling organic compound adds only a small vapour pressure, the mixture boils just below 100°C. That is why steam distillation can carry over high-boiling compounds without heating them to their boiling points.

28. Answer: (B) Statement I is false but Statement II is true.

Glycogen, the animal storage polysaccharide, is highly branched like amylopectin (and even more so), whereas amylose is an unbranched chain, so Statement I is false. Glycogen is stored in liver, muscle and brain, and is also found in yeast and fungi, so Statement II is true.

29. Answer: (D) B and E only

In this disproportionation Mn is +6 in MnO_4^{2-}, +7 in MnO_4^- and +4 in MnO_2. So +2 and +3 do not appear. Any choice that includes +6 or +7 lists a state that is present.

30. Answer: (C) Both Statement I and Statement II are true

The lowest-energy Balmer line is the n = 3 → 2 transition: wavenumber = $R_H(1/2^2 - 1/3^2) = R_H(1/4 - 1/9) = 5R_H/36$, so Statement I is true. For black-body radiation the peak of the intensity-wavelength curve shifts to shorter wavelength as temperature rises (Wien's displacement), so Statement II is true. $5R_H/36$ is not the series limit ($R_H/4$), which is the highest-energy Balmer line.

31. Answer: (A) n-propyl alcohol

P/I_2 converts ethanol to ethyl iodide, which is A; with Mg in dry ether it gives CH_3CH_2MgI, which is B. This adds to formaldehyde to give $CH_3CH_2CH_2OMgI$, which is C, and hydrolysis gives the primary alcohol $CH_3CH_2CH_2OH$, n-propyl alcohol, which is D. Formaldehyde always gives a primary alcohol with one more carbon; isopropyl alcohol would need acetaldehyde with CH_3MgX.

32. Answer: (B) The N–N single bond is as strong as the P–P single bond

The N–N single bond is weaker than the P–P single bond: the small N–N bond length brings the non-bonding lone pairs close and their repulsion weakens the bond. Nitrogen forms pπ–pπ multiple bonds because of its small size and has no d orbitals for dπ–pπ bonding, while P and As in ligands like $P(C_2H_5)_3$ and $As(C_6H_5)_3$ can form dπ–dπ bonds with transition metals. So those statements are correct.

33. Answer: (D) A-III, B-IV, C-II, D-I

The lake test (blue litmus adsorbed on $Al(OH)_3$) identifies Al^{3+}. Nessler's reagent gives a brown precipitate with NH_4^+ (as ammonia). Potassium sulphocyanide (thiocyanate) gives a blood-red colour with Fe^{3+}, and the brown ring test detects NO_3^-. Swapping the Al^{3+} and Fe^{3+} tests is the common error.

34. Answer: (D) A-IV, B-III, C-I, D-II

N_2 has a triple bond and the highest bond enthalpy, 946 kJ mol^{-1}; O_2 with a double bond has 498 kJ mol^{-1}. H–H is 435.8 kJ mol^{-1} and H–Cl is 431 kJ mol^{-1}, the two single bonds with close values. Swapping H_2 and HCl, or giving N_2 a value below O_2's, are the traps.

35. Answer: (A) −61.75 kJ mol^{-1}

$\Delta G° = -nFE°_{cell}$ with n = 2: $\Delta G° = -2 \times 96487 \times 0.32 = -61\,752$ J $mol^{-1} \approx -61.75$ kJ mol^{-1}. It is negative because $E°_{cell}$ is positive (spontaneous cell). The positive value has the wrong sign, and ±5.006 kJ does not follow from $-nFE°$ at all.

36. Answer: (A) A-II, B-III, C-IV, D-I

With dilute H_2SO_4, carbonate gives brisk effervescence of colourless, odourless CO_2; sulphide gives H_2S with its rotten-egg smell; sulphite gives SO_2 with a pungent (burning sulphur) smell; and nitrite gives brown fumes of NO_2. Matching sulphite with the colourless effervescence confuses SO_2's sharp smell with odourless CO_2.

37. Answer: (A) 10^{-4}

In water $s_0 = \sqrt{Ksp} = \sqrt{10^{-10}} = 10^{-5}$ M. In 0.1 M KCl the common Cl^- ion gives $s = Ksp/[Cl^-] = 10^{-10}/0.1 = 10^{-9}$ M. The ratio $s/s_0 = 10^{-9}/10^{-5} = 10^{-4}$. The value 10^{-9} is the solubility in KCl itself, not the ratio.

38. Answer: (B) 18.18% and 3.70%

%C = (12/44) × (0.2/0.3) × 100 = 0.0545/0.3 × 100 = 18.18%. %H = (2/18) × (0.1/0.3) × 100 = 0.0111/0.3 × 100 = 3.70%. The option with the same numbers reversed swaps carbon and hydrogen.

39. Answer: (A) F

Fluorine is so reactive that it reacts violently and uncontrollably with the arene, so aryl fluorides cannot be made by direct electrophilic fluorination; they are made via diazonium salts instead. Iodination is also unsuitable, but for the opposite reason: it is reversible and needs an oxidising agent to remove HI, so it is not about high reactivity.

40. Answer: (B) $R_1 = CH_3$; $R_2 = CH_3$; $R_3 = CH_3$

$KMnO_4$ oxidises an alkane that has a tertiary C–H bond to the tertiary alcohol: $(CH_3)_3CH$ (2-methylpropane) gives $(CH_3)_3COH$ (2-methylpropan-2-ol). With all three groups CH_3 the carbon is tertiary. Methane, ethane and propane (the other combinations) have only primary or secondary C–H bonds and are not converted this way.

41. Answer: (A) 19988.4 J

$\Delta n_g = 2 - (1 + 3) = -2$. $\Delta U = \Delta H - \Delta n_g RT = 15\,000$ J $- (-2)(8.314)(300)$ J $= 15\,000 + 4988.4 = 19\,988.4$ J. Using $\Delta n_g = +2$ would give 10 011.6 J; the values around 2 kJ come from misplacing the decimal.

42. Answer: (C) 18219 J

$\log(k_2/k_1) = (Ea/2.303R)(1/T_1 - 1/T_2)$. $k_2/k_1 = 0.14/0.04 = 3.5$, and $1/500 - 1/700 = 200/350\,000 = 1/1750$ K^{-1}. So $Ea = 0.5441 \times 2.303 \times 8.31 \times 1750 \approx 18\,220$ J, i.e. 18219 J (the small difference is rounding of 2.303). 182310 J is ten times too large.

43. Answer: (D) 45 g

Isotonic solutions of non-electrolytes have equal molar concentrations. Urea (M = 60 g mol^{-1}): 15/60 = 0.25 mol L^{-1}. Glucose (M = 180 g mol^{-1}) at 0.25 mol L^{-1} needs 0.25 × 180 = 45 g in one litre. Taking the same mass, 15 g, ignores the different molar masses.

44. Answer: (D) Only A, B, D

Both carbonyls have a metal-metal bond, terminal CO groups and the metal in the zero oxidation state (CO is neutral). $[Mn_2(CO)_{10}]$ has only terminal CO ligands, with five on each Mn joined by a Mn–Mn bond, whereas $[Co_2(CO)_8]$ also has two bridging CO groups. Bridging CO is therefore not common to both.

45. Answer: (C) hyperconjugation

The σ electrons of the C–H bonds of the methyl group overlap with the empty p orbital of the carbocation carbon (σ–p conjugation, called hyperconjugation), which spreads out the positive charge. A methyl group is electron-releasing (+I), not −I, and it has no π system for a mesomeric effect.

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