

AIPMT 2006 Prelims — Chemistry Question Paper with Solutions

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

AIPMT 2006 Prelims · Q1

1. In producing chlorine through electrolysis 100 W power at 125 V is being consumed. How much chlorine per min is liberated ? ECE of chlorine is 0.367×10^{-6} kg/C :

- (A) 17.6 mg
- (B) 34.3 mg
- (C) 24.3 mg
- (D) 39.6 mg

AIPMT 2006 Prelims · Q51

2. Identify the correct statement for change of Gibbs energy for a system (ΔG_{system}) at constant temperature and pressure :

- (A) If $\Delta G_{\text{system}} > 0$, the process is spontaneous
- (B) If $\Delta G_{\text{system}} = 0$, the system has attained equilibrium
- (C) If $\Delta G_{\text{system}} = 0$, the system is still moving in a particular direction
- (D) If $\Delta G_{\text{system}} < 0$, the process is not spontaneous

AIPMT 2006 Prelims · Q52

3. A solution containing 10 g per dm^3 of urea (molecular mass = 60 g mol^{-1}) is isotonic with a 5% solution of a non-volatile solute. The molecular mass of this non-volatile solute is :

- (A) 200 g mol^{-1}
- (B) 300 g mol^{-1}
- (C) 400 g mol^{-1}
- (D) 500 g mol^{-1}

AIPMT 2006 Prelims · Q53

4. A plot of $\log x/m$ versus $\log p$ for the adsorption of a gas on a solid gives a straight line with slope equal to :

- (A) $-\log k$
- (B) n
- (C) $1/n$
- (D) $\log k$

AIPMT 2006 Prelims · Q54

5. Assume each reaction is carried out in an open container. For which reaction will $\Delta H = \Delta E$?

- (A) $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$
- (B) $\text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{H}_2(\text{g}) + \text{CO}_2(\text{g})$
- (C) $\text{PCl}_5(\text{g}) \rightarrow \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
- (D) $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g})$

AIPMT 2006 Prelims · Q55

6. In a set of reactions propionic acid yielded a compound D.

$\text{CH}_3\text{CH}_2\text{COOH} \xrightarrow{(\text{SOCl}_2)} \text{B} \xrightarrow{(\text{NH}_3)} \text{C} \xrightarrow{(\text{KOH}, \text{Br}_2)} \text{D}$

The structure of D would be :

- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
- (B) $\text{CH}_3\text{CH}_2\text{CONH}_2$
- (C) $\text{CH}_3\text{CH}_2\text{NHCH}_3$
- (D) $\text{CH}_3\text{CH}_2\text{NH}_2$

7. The human body does not produce :

- (A) DNA
- (B) vitamins
- (C) hormones
- (D) enzymes

8. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avogadro number being $6.02 \times 10^{23} \text{ mol}^{-1}$, the density of CsBr is :

- (A) 42.5 g/cm³
- (B) 2.25 g/cm³
- (C) 0.225 g/cm³
- (D) 4.25 g/cm³

9. More number of oxidation states are exhibited by the actinoids than by the lanthanoids. The main reason for this is :

- (A) more energy difference between 5f and 6d orbitals than that between 4f and 5d orbitals
- (B) lesser energy difference between 5f and 6d orbitals than that between 4f and 5d orbitals
- (C) greater metallic character of the lanthanoids than that of the corresponding actinoids
- (D) more active nature of the actinoids

10. Given : The mass of electron is $9.11 \times 10^{-31} \text{ kg}$, Planck constant is $6.626 \times 10^{-34} \text{ Js}$, the uncertainty involved in the measurement of velocity within a distance of 0.1 Å is :

- (A) $5.79 \times 10^6 \text{ m s}^{-1}$
- (B) $5.79 \times 10^7 \text{ m s}^{-1}$
- (C) $5.79 \times 10^8 \text{ m s}^{-1}$
- (D) $5.79 \times 10^9 \text{ m s}^{-1}$

11. Copper sulphate dissolves in excess of KCN to give :

- (A) CuCN
- (B) $[\text{Cu}(\text{CN})_4]^{3-}$
- (C) $[\text{Cu}(\text{CN})_4]^{2-}$
- (D) $\text{Cu}(\text{CN})_2$

12. In which of the following pairs are both the ions coloured in aqueous solution ? (At. no. : Sc = 21, Ti = 22, Ni = 28, Cu = 29, Co = 27)

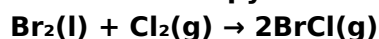
- (A) Ni^{2+} , Ti^{3+}
- (B) Sc^{3+} , Ti^{3+}
- (C) Sc^{3+} , Co^{2+}
- (D) Ni^{2+} , Cu^+

13. Al_2O_3 can be converted to anhydrous AlCl_3 by heating :

- (A) Al_2O_3 with HCl gas
- (B) Al_2O_3 with NaCl in solid state
- (C) a mixture of Al_2O_3 and carbon in dry Cl_2 gas
- (D) Al_2O_3 with Cl_2 gas

AIPMT 2006 Prelims · Q64

14. The enthalpy and entropy change for the reaction :



are 30 kJ mol^{-1} and $105 \text{ J K}^{-1} \text{ mol}^{-1}$ respectively. The temperature at which the reaction will be in equilibrium is :

- (A) 285.7 K
- (B) 373 K
- (C) 250 K
- (D) 400 K

AIPMT 2006 Prelims · Q65

15. The appearance of colour in solid alkali metal halides is generally due to :

- (A) F-centres
- (B) Schottky defect
- (C) Frenkel defect
- (D) Interstitial positions

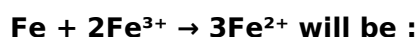
AIPMT 2006 Prelims · Q66

16. The general molecular formula, which represents the homologous series of alkanols is :

- (A) $\text{C}_n\text{H}_{2n}\text{O}_2$
- (B) $\text{C}_n\text{H}_{2n}\text{O}$
- (C) $\text{C}_n\text{H}_{2n+1}\text{O}$
- (D) $\text{C}_n\text{H}_{2n+2}\text{O}$

AIPMT 2006 Prelims · Q67

17. If $E^\circ(\text{Fe}^{2+}/\text{Fe}) = -0.441 \text{ V}$ and $E^\circ(\text{Fe}^{3+}/\text{Fe}^{2+}) = 0.771 \text{ V}$, the standard emf of the reaction :



- (A) 0.441 V
- (B) 1.753 V
- (C) 1.212 V
- (D) 0.211 V

AIPMT 2006 Prelims · Q68

18. For the reaction $2\text{A} + \text{B} \rightarrow 3\text{C} + \text{D}$ which of the following does not express the reaction rate ?

- (A) $-\text{d}[\text{C}]/3\text{d}t$
- (B) $-\text{d}[\text{B}]/\text{d}t$
- (C) $\text{d}[\text{D}]/\text{d}t$
- (D) $-\text{d}[\text{A}]/2\text{d}t$

AIPMT 2006 Prelims · Q69

19. For the reaction,



Which of the following statements is not true ?

- (A) At equilibrium, the concentrations of $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ are not equal
- (B) The equilibrium constant for the reaction is given by $K_p = [\text{CO}_2]/[\text{CH}_4][\text{O}_2]$
- (C) Addition of $\text{CH}_4(\text{g})$ or $\text{O}_2(\text{g})$ at equilibrium will cause a shift to the right
- (D) The reaction is exothermic

AIPMT 2006 Prelims · Q70

20. $[\text{NH}(\text{CH}_2)_6\text{NHCO}(\text{CH}_2)_4\text{CO}]_n$ is a :

- (A) co-polymer
- (B) addition polymer
- (C) thermo-setting polymer
- (D) homopolymer

AIPMT 2006 Prelims · Q71

21. A carbonyl compound reacts with hydrogen cyanide to form cyanohydrin which on hydrolysis forms a racemic mixture of α -hydroxy acid. The carbonyl compound is :

- (A) acetaldehyde
- (B) acetone
- (C) diethyl ketone
- (D) formaldehyde

AIPMT 2006 Prelims · Q72

22. Which one of the following is a peptide hormone ?

- (A) Glucagon
- (B) Testosterone
- (C) Thyroxin
- (D) Adrenaline

AIPMT 2006 Prelims · Q73

23. The major organic product in the reaction, $\text{CH}_3\text{-O-CH(CH}_3)_2 + \text{HI} \rightarrow$ Product is :

- (A) $\text{CH}_3\text{OH} + (\text{CH}_3)_2\text{CHI}$
- (B) $\text{ICH}_2\text{OCH(CH}_3)_2$
- (C) $\text{CH}_3\text{O-C(CH}_3)_2\text{I}$
- (D) $\text{CH}_3\text{I} + (\text{CH}_3)_2\text{CHOH}$

AIPMT 2006 Prelims · Q74

24. Nucleophilic addition reaction will be most favoured in :

- (A) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CO-CH}_3$
- (B) $(\text{CH}_3)_2\text{C=O}$
- (C) $\text{CH}_3\text{CH}_2\text{CHO}$
- (D) CH_3CHO

AIPMT 2006 Prelims · Q75

25. The enthalpy of combustion of H_2 , cyclohexene (C_6H_{10}) and cyclohexane (C_6H_{12}) are -241 , -3800 and -3920 kJ per mol respectively. Heat of hydrogenation of cyclohexene is :

- (A) -121 kJ per mol
- (B) $+121$ kJ per mol
- (C) $+484$ kJ per mol
- (D) -484 kJ per mol

AIPMT 2006 Prelims · Q76

26. Self condensation of two moles of ethyl acetate in presence of sodium ethoxide yields :

- (A) ethyl butyrate
- (B) acetoacetic ester
- (C) methyl acetoacetate
- (D) ethyl propionate

AIPMT 2006 Prelims · Q77

27. Consider the reaction $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$. The equality relationship between $\text{d}[\text{NH}_3]/\text{dt}$ and $-\text{d}[\text{H}_2]/\text{dt}$ is :

- (A) $\text{d}[\text{NH}_3]/\text{dt} = -(1/3) \text{d}[\text{H}_2]/\text{dt}$
- (B) $\text{d}[\text{NH}_3]/\text{dt} = -(2/3) \text{d}[\text{H}_2]/\text{dt}$
- (C) $\text{d}[\text{NH}_3]/\text{dt} = -(3/2) \text{d}[\text{H}_2]/\text{dt}$
- (D) $\text{d}[\text{NH}_3]/\text{dt} = -\text{d}[\text{H}_2]/\text{dt}$

AIPMT 2006 Prelims · Q78

28. Which of the following is not chiral ?

- (A) 2-butanol
- (B) 2, 3-dibromopentane
- (C) 3-bromopentane
- (D) 2-hydroxypropanoic acid

AIPMT 2006 Prelims · Q79

29. $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{Cl}$ exhibits :

- (A) linkage isomerism, ionization isomerism and optical isomerism
- (B) linkage isomerism, ionization isomerism and geometrical isomerism
- (C) ionization isomerism, geometrical isomerism and optical isomerism
- (D) linkage isomerism, geometrical isomerism and optical isomerism

AIPMT 2006 Prelims · Q80

30. $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ (at. no. of Cr = 24) has a magnetic moment of 3.83 BM, the correct distribution of 3d electrons in the chromium of the complex is :

- (A) $3d^1(x^2-y^2)$, $3d^1(z^2)$, $3d^1(xz)$
- (B) $3d^1(xy)$, $3d^1(x^2-y^2)$, $3d^1(yz)$
- (C) $3d^1(xy)$, $3d^1(zx)$, $3d^1(xz)$
- (D) $3d^1(xy)$, $3d^1(yz)$, $3d^1(z^2)$

AIPMT 2006 Prelims · Q81

31. 1.00 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant, K_f of benzene is $5.12 \text{ K kg mol}^{-1}$, the freezing point of benzene will be lowered by :

- (A) 0.4 K
- (B) 0.8 K
- (C) 0.12 K
- (D) 0.24 K

AIPMT 2006 Prelims · Q82

32. Which of the following pairs constitutes a buffer ?

- (A) HNO_2 and NaNO_2
- (B) NaOH and NaCl
- (C) HNO_3 and NH_4NO_3
- (D) HCl and KCl

AIPMT 2006 Prelims · Q83

33. The hydrogen ion concentration of a 10^{-8} M HCl aqueous solution at 298 K ($K_w = 10^{-14}$) is :

- (A) $1.0525 \times 10^{-6} \text{ M}$
- (B) $1.0525 \times 10^{-7} \text{ M}$
- (C) $8.525 \times 10^{-8} \text{ M}$
- (D) $1.0525 \times 10^{-8} \text{ M}$

AIPMT 2006 Prelims · Q84

34. A solution of acetone in ethanol :

- (A) shows a negative deviation from Raoult's law
- (B) shows a positive deviation from Raoult's law
- (C) behaves like a near ideal solution
- (D) obeys Raoult's law

AIPMT 2006 Prelims · Q85

35. A hypothetical electrochemical cell is shown below

A | A⁺ (xM) || B⁺ (yM) | B

The emf measured is +0.20 V. The cell reaction is :

- (A) $A^+ + B \rightarrow A + B^+$
- (B) $A^+ + e^- \rightarrow A$; $B^+ + e^- \rightarrow B$
- (C) the cell reaction cannot be predicted
- (D) $A + B^+ \rightarrow A^+ + B$

AIPMT 2006 Prelims · Q86

36. Ethylene oxide when treated with Grignard reagent yields :

- (A) secondary alcohol
- (B) tertiary alcohol
- (C) cyclopropyl alcohol
- (D) primary alcohol

AIPMT 2006 Prelims · Q88

37. Which of the following is more basic than aniline ?

- (A) Diphenylamine
- (B) Triphenylamine
- (C) p-nitroaniline
- (D) Benzylamine

AIPMT 2006 Prelims · Q89

38. In which of the following molecules are all the bonds not equal ?

- (A) ClF_3
- (B) BF_3
- (C) AlF_3
- (D) NF_3

AIPMT 2006 Prelims · Q90

39. The electronegativity difference between N and F is greater than that between N and H yet the dipole moment of NH_3 (1.5 D) is larger than that of NF_3 (0.2 D). This is because :

- (A) in NH_3 as well as in NF_3 the atomic dipole and bond dipole are in the same direction
- (B) in NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions
- (C) in NH_3 as well as NF_3 the atomic dipole and bond dipole are in opposite directions
- (D) in NH_3 the atomic dipole and bond dipole are in the opposite directions whereas in NF_3 these are in the same directions

AIPMT 2006 Prelims · Q91

40. The correct order of the mobility of the alkali metal ions in aqueous solution is :

- (A) $Li^+ > Na^+ > K^+ > Rb^+$
- (B) $Na^+ > K^+ > Rb^+ > Li^+$
- (C) $K^+ > Rb^+ > Na^+ > Li^+$
- (D) $Rb^+ > K^+ > Na^+ > Li^+$

AIPMT 2006 Prelims · Q92

41. The correct order regarding the electronegativity of hybrid orbitals of carbon is :

- (A) $sp > sp^2 < sp^3$
- (B) $sp > sp^2 > sp^3$
- (C) $sp < sp^2 > sp^3$
- (D) $sp < sp^2 < sp^3$

AIPMT 2006 Prelims · Q93

42. Which of the following species has a linear shape ?

- (A) NO_2^-
- (B) SO_2
- (C) NO_2^+
- (D) O_3

AIPMT 2006 Prelims · Q94

43. Which of the following is the most basic oxide ?

- (A) Al_2O_3
- (B) Sb_2O_3
- (C) Bi_2O_3
- (D) SeO_2

AIPMT 2006 Prelims · Q95

44. The orientation of an atomic orbital is governed by :

- (A) azimuthal quantum number
- (B) spin quantum number
- (C) magnetic quantum number
- (D) principal quantum number

AIPMT 2006 Prelims · Q96

45. Which of the following is not a correct statement ?

- (A) The electron-deficient molecules can act as Lewis acids
- (B) The canonical structures have no real existence
- (C) Every AB_5 molecule does in fact have square pyramid structure
- (D) Multiple bonds are always shorter than corresponding single bonds

AIPMT 2006 Prelims · Q97

46. The number of unpaired electrons in a paramagnetic diatomic molecule of an element with atomic number 16 is :

- (A) 2
- (B) 3
- (C) 4
- (D) 1

AIPMT 2006 Prelims · Q98

47. Which one of the following orders is not in accordance with the property stated against it?

- (A) $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$: Oxidising power
- (B) $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$: Acidic property in water
- (C) $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$: Electronegativity
- (D) $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$: Bond dissociation energy

AIPMT 2006 Prelims · Q99

48. Which of the following is not isostructural with SiCl_4 ?

- (A) SCl_4
- (B) SO_4^{2-}
- (C) PO_4^{3-}
- (D) NH_4^+

AIPMT 2006 Prelims · Q100

49. The IUPAC name of $\text{CH}_3\text{CH}_2\text{-CH}(\text{CH}_3)\text{-CH}(\text{CH}_3)\text{-COCl}$ is :

- (A) 3, 4-dimethylpentanoyl chloride
- (B) 1-chloro-1-oxo-2, 3-dimethylpentane
- (C) 2-ethyl-3-methylbutanoyl chloride
- (D) 2, 3-dimethylpentanoyl chloride

Answer key and explanations

1. Answer: (A) 17.6 mg

The current drawn is $I = P/V = 100/125 = 0.8$ A, so the charge passed in one minute is $0.8 \times 60 = 48$ C. By Faraday's first law $m = ZQ = 0.367 \times 10^{-6} \times 48 \approx 1.76 \times 10^{-5}$ kg = 17.6 mg. Forgetting the 60 s factor or using V instead of I gives none of the other values.

2. Answer: (B) If $\Delta G_{\text{system}} = 0$, the system has attained equilibrium

At constant temperature and pressure $\Delta G < 0$ means spontaneous, $\Delta G > 0$ means non-spontaneous, and $\Delta G = 0$ means the system is at equilibrium. So $\Delta G = 0$ marks equilibrium, with no net change in any direction. The other statements reverse these signs.

3. Answer: (B) 300 g mol⁻¹

Isotonic solutions of non-electrolytes have equal molar concentrations. Urea: $10 \text{ g/L} \div 60 = 1/6 \text{ mol/L}$. A 5% solution has 50 g/L (taking 5 g per 100 mL), so $50/M = 1/6$ and $M = 300 \text{ g mol}^{-1}$.

4. Answer: (C) 1/n

The Freundlich isotherm is $x/m = kp^{(1/n)}$; taking logs, $\log(x/m) = \log k + (1/n) \log p$. A plot of $\log(x/m)$ against $\log p$ is a straight line with slope $1/n$ and intercept $\log k$.

5. Answer: (A) $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$

$\Delta H = \Delta E + \Delta n_g RT$, so $\Delta H = \Delta E$ only when the number of moles of gas is unchanged. For $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$, $\Delta n_g = 2 - 2 = 0$. The water-gas reaction and the PCl_5 decomposition have $\Delta n_g = +1$, and the CO combustion has $\Delta n_g = -1$.

6. Answer: (D) $\text{CH}_3\text{CH}_2\text{NH}_2$

SOCl_2 converts the acid to propanoyl chloride, $\text{CH}_3\text{CH}_2\text{COCl}$, and NH_3 then gives propanamide, $\text{CH}_3\text{CH}_2\text{CONH}_2$. Br_2/KOH carries out the Hofmann bromamide degradation, removing one carbon to give ethylamine, $\text{CH}_3\text{CH}_2\text{NH}_2$, as the final compound. Propylamine would keep all three carbons, and propanamide is only the intermediate before the Hofmann step.

7. Answer: (B) vitamins

The human body synthesises its own DNA, hormones and enzymes, but most vitamins cannot be made in adequate amounts and must come from the diet. That is why vitamins are called essential dietary factors.

8. Answer: (D) 4.25 g/cm³

CsBr has the CsCl -type structure: one Cs^+ at the body centre and $8 \times \frac{1}{8} = 1$ Br^- at the corners, so $Z = 1$ formula unit. $\rho = ZM/(N_A a^3) = 213/(6.02 \times 10^{23} \times (4.366 \times 10^{-8} \text{ cm})^3) = 213/(6.02 \times 10^{23} \times 8.32 \times 10^{-23}) \approx 4.25 \text{ g/cm}^3$. Taking $Z = 2$ for a bcc lattice would double this to 8.5 g/cm^3 .

9. Answer: (B) lesser energy difference between 5f and 6d orbitals than that between 4f and 5d orbitals

In actinoids the 5f, 6d and 7s orbitals are very close in energy, closer than 4f, 5d and 6s in lanthanoids, and 5f electrons are less tightly held. So more electrons can take part in bonding, giving many more oxidation states. A larger 5f-6d gap would have the opposite effect.

10. Answer: (A) $5.79 \times 10^6 \text{ m s}^{-1}$

Heisenberg: $\Delta x \cdot m \Delta v \geq h/4\pi$, so $\Delta v = 6.626 \times 10^{-34}/(4 \times 3.1416 \times 9.11 \times 10^{-31} \times 1 \times 10^{-11}) = 6.626 \times 10^{-34}/1.145 \times 10^{-40} \approx 5.79 \times 10^6 \text{ m s}^{-1}$. Remember $0.1 \text{ \AA} = 10^{-11} \text{ m}$; using 10^{-10} m would change the power of ten.

11. Answer: (B) $[\text{Cu}(\text{CN})_4]^{3-}$

CN^- reduces Cu^{2+} to Cu^+ ($2\text{Cu}^{2+} + 4\text{CN}^- \rightarrow 2\text{CuCN} + (\text{CN})_2$), and CuCN dissolves in excess cyanide to give the stable tetracyanidocuprate(I) ion, $[\text{Cu}(\text{CN})_4]^{3-}$. The Cu(II) complex $[\text{Cu}(\text{CN})_4]^{2-}$ is not the product, and CuCN is only the intermediate before excess KCN acts.

12. Answer: (A) Ni^{2+} , Ti^{3+}

Colour needs partly filled d orbitals for d-d transitions. Ni^{2+} ($3d^8$) and Ti^{3+} ($3d^1$) are both coloured. Sc^{3+} is $3d^0$ and Cu^+ is $3d^{10}$, so each pair containing one of them has a colourless ion.

13. Answer: (C) a mixture of Al_2O_3 and carbon in dry Cl_2 gas

Heating Al_2O_3 with carbon in dry chlorine removes the oxygen as CO while chlorine combines with aluminium: $\text{Al}_2\text{O}_3 + 3\text{C} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{CO}$. Without carbon, Cl_2 alone cannot displace oxygen from the very stable oxide, and HCl would give hydrated, not anhydrous, products.

14. Answer: (A) 285.7 K

At equilibrium $\Delta G = \Delta H - T\Delta S = 0$, so $T = \Delta H/\Delta S = 30\,000 \text{ J mol}^{-1}/105 \text{ J K}^{-1} \text{ mol}^{-1} = 285.7 \text{ K}$. Forgetting to convert kJ to J gives a meaningless 0.29 K.

15. Answer: (A) F-centres

When alkali halide crystals are heated in alkali-metal vapour, anion vacancies form and trap electrons; these F-centres absorb visible light and colour the crystal (e.g. NaCl turns yellow). Schottky and Frenkel defects by themselves do not produce colour.

16. Answer: (D) $C_nH_{2n+2}O$

Alkanols are $C_nH_{2n+1}OH$, which written as a molecular formula is $C_nH_{2n+2}O$ (e.g. CH_4O for methanol, C_2H_6O for ethanol). $C_nH_{2n}O$ fits aldehydes and ketones, and $C_nH_{2n}O_2$ fits acids and esters.

17. Answer: (C) 1.212 V

Fe is oxidised to Fe^{2+} (anode) and Fe^{3+} is reduced to Fe^{2+} (cathode). $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.771 - (-0.441) = 1.212$ V. Electrode potentials are intensive, so they are not multiplied by 2; simply adding them gives the wrong 0.33 V.

18. Answer: (A) $-d[C]/3dt$

Rate = $-\frac{1}{2} d[A]/dt = -d[B]/dt = +\frac{1}{3} d[C]/dt = +d[D]/dt$. Since C is a product its concentration rises, so $-d[C]/3dt$ is negative and cannot represent the rate. The other three expressions are correct.

19. Answer: (B) The equilibrium constant for the reaction is given by $K_p = [CO_2]/[CH_4][O_2]$

The correct expression excludes the pure liquid H_2O and raises O_2 to its coefficient: $K_p = p(CO_2)/[p(CH_4) \cdot p(O_2)^2]$. The given $K_p = [CO_2]/[CH_4][O_2]$ omits the square on O_2 , so it is the false statement. Adding a reactant shifts the equilibrium right, and a negative $\Delta_r H$ means exothermic.

20. Answer: (A) co-polymer

This is nylon-6,6, made by condensing hexamethylenediamine with adipic acid. Since its repeating unit comes from two different monomers it is a copolymer. It is a condensation (not addition) polymer and a thermoplastic fibre, not a thermosetting one.

21. Answer: (A) acetaldehyde

Acetaldehyde adds HCN to give $CH_3CH(OH)CN$, whose central carbon has four different groups; attack from either face is equally likely, so a racemic cyanohydrin and, on hydrolysis, racemic lactic acid result. Formaldehyde, acetone and diethyl ketone give cyanohydrins with two identical groups, which are achiral.

22. Answer: (A) Glucagon

Glucagon is a peptide hormone of 29 amino acids made by pancreatic α -cells. Testosterone is a steroid, while thyroxine and adrenaline are derived from the amino acid tyrosine and are not peptides.

23. Answer: (D) $CH_3I + (CH_3)_2CHOH$

HI protonates the ether oxygen and I^- attacks by SN_2 at the less hindered carbon, which is the methyl group. The products are CH_3I and isopropyl alcohol, $(CH_3)_2CHOH$. Attack at the secondary isopropyl carbon, giving CH_3OH and isopropyl iodide, is slower under these conditions.

24. Answer: (D) CH_3CHO

Aldehydes are more reactive than ketones towards nucleophiles because they have less steric hindrance and only one electron-releasing alkyl group. Among the aldehydes, CH_3CHO has a smaller alkyl group than CH_3CH_2CHO , so it reacts most readily. Both ketones are less reactive.

25. Answer: (A) -121 kJ per mol

For $C_6H_{10} + H_2 \rightarrow C_6H_{12}$, $\Delta H = \sum \Delta_c H(\text{reactants}) - \sum \Delta_c H(\text{products}) = (-3800 - 241) - (-3920) = -121$ kJ mol $^{-1}$. Reversing the subtraction gives +121 kJ mol $^{-1}$, but hydrogenation of an alkene is exothermic.

26. Answer: (B) acetoacetic ester

In the Claisen condensation, ethoxide removes an α -hydrogen from one ethyl acetate molecule and the carbanion attacks the carbonyl of another, expelling ethoxide. The product is $CH_3COCH_2COOC_2H_5$, ethyl acetoacetate (acetoacetic ester). It keeps the ethyl ester group, so it is not methyl acetoacetate.

27. Answer: (B) $d[NH_3]/dt = -(2/3) d[H_2]/dt$

Rate = $-\frac{1}{3} d[H_2]/dt = \frac{1}{2} d[NH_3]/dt$. Therefore $d[NH_3]/dt = -(2/3) d[H_2]/dt$: two moles of NH_3 form for every three moles of H_2 used. The ratio 3/2 inverts the stoichiometry.

28. Answer: (C) 3-bromopentane

In 3-bromopentane, C-3 carries H, Br and two identical ethyl groups, so there is no stereocentre and the molecule is achiral. 2-Butanol and lactic acid each have a carbon with four different groups, and 2,3-dibromopentane has two such carbons with no internal symmetry.

29. Answer: (B) linkage isomerism, ionization isomerism and geometrical isomerism

NO_2^- can bind through N (nitro) or O (nitrito), giving linkage isomers. Exchanging Cl^- with a coordinated NO_2^- gives ionisation isomers, and the two NO_2 ligands can be cis or trans, giving geometrical isomers. Neither cis nor trans $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]^+$ is chiral, because each has mirror planes, so optical isomerism is absent.

30. Answer: (C) $3d^1(xy)$, $3d^1(zy)$, $3d^1(xz)$

$\mu = \sqrt{n(n+2)} = 3.83 \text{ BM}$ gives $n = 3$ unpaired electrons, matching Cr^{3+} ($3d^3$). In the octahedral field of six water ligands these three electrons occupy the lower t_{2g} set, d_{xy} , d_{yz} and d_{xz} , one each. Any set that includes $d_{x^2-y^2}$ or d_{z^2} places an electron in the higher e_g level.

31. Answer: (A) 0.4 K

Molality $m = (1.00/250)/(51.2/1000) = 0.004/0.0512 = 0.078 \text{ mol kg}^{-1}$. $\Delta T_f = K_f \times m = 5.12 \times 0.078 = 0.40 \text{ K}$. Forgetting to convert grams of benzene to kilograms changes the answer by a factor of 1000.

32. Answer: (A) HNO_2 and NaNO_2

A buffer needs a weak acid with its conjugate base (or weak base with its conjugate acid). HNO_2 is a weak acid and NaNO_2 supplies NO_2^- , so this pair is an acidic buffer. The other pairs contain a strong acid or strong base with a neutral salt and cannot resist pH changes.

33. Answer: (B) $1.0525 \times 10^{-7} \text{ M}$

At 10^{-8} M the acid's H^+ is smaller than that from water, so both must be counted: $x(x - 10^{-8}) = 10^{-14}$. Solving, $x = [10^{-8} + \sqrt{(10^{-16} + 4 \times 10^{-14})}]/2 \approx 1.05 \times 10^{-7} \text{ M}$ ($\text{pH} \approx 6.98$). Taking $[\text{H}^+] = 10^{-8} \text{ M}$ would make an acid solution basic ($\text{pH} 8$).

34. Answer: (B) shows a positive deviation from Raoult's law

Ethanol molecules are hydrogen bonded to one another; acetone gets between them and breaks many of these bonds while forming weaker interactions. The escaping tendency increases, so the vapour pressure is higher than Raoult's law predicts, a positive deviation. A negative deviation would need stronger A-B attractions, as in acetone-chloroform.

35. Answer: (D) $\text{A} + \text{B}^+ \rightarrow \text{A}^+ + \text{B}$

In the cell notation the left electrode is the anode (oxidation) and the right the cathode (reduction). A positive emf of $+0.20 \text{ V}$ means this cell is spontaneous as written: $\text{A} \rightarrow \text{A}^+ + \text{e}^-$ and $\text{B}^+ + \text{e}^- \rightarrow \text{B}$, i.e. $\text{A} + \text{B}^+ \rightarrow \text{A}^+ + \text{B}$. The reverse reaction would have a negative emf.

36. Answer: (D) primary alcohol

The carbanion of RMgX attacks a ring carbon of ethylene oxide and opens the strained ring, giving $\text{RCH}_2\text{CH}_2\text{OMgX}$. Hydrolysis yields $\text{RCH}_2\text{CH}_2\text{OH}$, a primary alcohol with two more carbons than R. Secondary and tertiary alcohols come from aldehydes and ketones with Grignard reagents.

37. Answer: (D) Benzylamine

In benzylamine, $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$, the CH_2 group separates nitrogen from the ring, so its lone pair is not delocalised and it behaves like an alkylamine, more basic than aniline. In diphenylamine and triphenylamine the lone pair is spread over two or three rings, and the nitro group in p-nitroaniline withdraws electrons, so all three are weaker than aniline.

38. Answer: (A) ClF_3

ClF_3 has 3 bond pairs and 2 lone pairs on Cl (sp^3d), giving a T shape with two longer axial Cl-F bonds and one shorter equatorial bond. BF_3 and AlF_3 are trigonal planar and NF_3 is pyramidal, each with three identical bonds.

39. Answer: (B) in NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions

In NH_3 the lone pair's orbital dipole points away from N, the same way as the N-H bond dipoles (towards N), so they add up to 1.5 D. In NF_3 the N-F bond dipoles point towards the F atoms, opposite to the lone-pair dipole, so they largely cancel, leaving only 0.2 D.

40. Answer: (D) $\text{Rb}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$

The smaller the ion, the more strongly it is hydrated, so Li^+ carries the largest hydration shell and moves slowest. Hydrated size decreases down the group, so mobility in water is $\text{Rb}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$, the reverse of the order of bare ionic size.

41. Answer: (B) $\text{sp} > \text{sp}^2 > \text{sp}^3$

The more s-character in a hybrid orbital, the closer its electrons are held to the nucleus and the more electronegative it is. s-character is 50% in sp , 33% in sp^2 and 25% in sp^3 , so electronegativity is $\text{sp} > \text{sp}^2 > \text{sp}^3$. This is why ethyne's C-H is the most acidic.

42. Answer: (C) NO_2^+

NO_2^+ has two bond pairs and no lone pair on N (sp hybridised), like the isoelectronic CO_2 , so it is linear. NO_2^- , SO_2 and O_3 each have a lone pair on the central atom and are bent.

43. Answer: (C) Bi_2O_3

Basic character of oxides increases with metallic character, which rises down a group and falls across a period. Bi_2O_3 , from the most metallic element listed, is basic; Sb_2O_3 and Al_2O_3 are amphoteric and SeO_2 is acidic.

44. Answer: (C) magnetic quantum number

The magnetic quantum number m_l fixes the orientation of an orbital in space, e.g. the three p orbitals along x, y and z. The azimuthal quantum number fixes the shape, the principal quantum number the size and energy, and the spin quantum number refers to the electron, not the orbital.

45. Answer: (C) Every AB_5 molecule does in fact have square pyramid structure

AB_5 molecules with no lone pair, such as PCl_5 , are trigonal bipyramidal; only those with a lone pair (AB_5E , e.g. BrF_5) are square pyramidal. So the claim that every AB_5 molecule is square pyramidal is false. The other three statements are standard facts.

46. Answer: (A) 2

Z = 16 is sulphur. S_2 is isoelectronic in its valence shell with O_2 , and its two highest electrons occupy the two degenerate π^* orbitals singly (Hund's rule). So S_2 has 2 unpaired electrons and is paramagnetic.

47. Answer: (D) $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$: Bond dissociation energy

Bond dissociation energy of the halogens is $\text{Cl}_2 > \text{Br}_2 > \text{F}_2 > \text{I}_2$, because the small F atoms' lone pairs repel and weaken the F-F bond. So the order $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$ for bond energy is incorrect, while it is correct for oxidising power and electronegativity, and $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$ is the correct acid-strength order.

48. Answer: (A) SCl_4

SiCl_4 , SO_4^{2-} , PO_4^{3-} and NH_4^+ all have four bond pairs and no lone pair on the central atom, so they are tetrahedral. SCl_4 has four bond pairs and one lone pair on S (sp^3d), giving a see-saw shape, so it is not isostructural.

49. Answer: (D) 2, 3-dimethylpentanoyl chloride

The principal chain includes the $-\text{COCl}$ carbon and has five carbons; numbering starts from that carbon (C-1). Methyl groups sit on C-2 and C-3, so the name is 2,3-dimethylpentanoyl chloride. Numbering from the other end, or choosing a four-carbon chain with an ethyl branch, breaks the IUPAC rules.

Questions as set in the AIPMT/NEET papers conducted by CBSE and NTA. Answers checked and explanations written by the RankUp team. RankUp is not affiliated with CBSE or NTA.