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JAM – 2018 – CY

Attempt ALL the questions. Q.1 – Q.10 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

1. On hydrolysis, aluminium carbide produces.

(a) CH_4 (b) C_2H_6 (c) C_2H_4 (d) C_2H_2

2. Carbonic anhydrase is an example of

(a) Hydrolysis enzyme (b) Redox enzyme (c) O_2 transport protein (d) Heme protein

3. The CORRECT order of melting points of group 15 trifluorides is

(a) $PF_3 < AsF_3 < SbF_3 < BiF_3$

(b) $BiF_3 < SbF_3 < PF_3 < AsF_3$

(c) $PF_3 < SbF_3 < AsF_3 < BiF_3$

(d) $BiF_3 < AsF_3 < SbF_3 < PF_3$

4. NaF, KF, MgO and CaO are crystalline solids. They have NaCl structure. Their lattice energies vary in the order

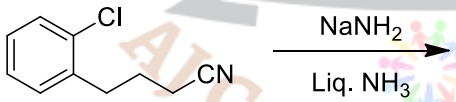
(a) NaF < KF < MgO < CaO

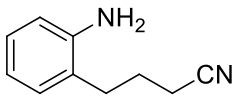
(b) KF < NaF < CaO < MgO

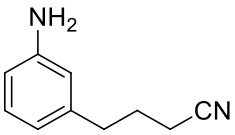
(c) MgO < CaO < NaF < KF

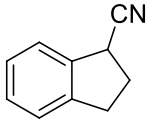
(d) CaO < MgO < KF < NaF

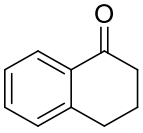
5. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

6. The compound that contains the most acidic hydrogen is

(a) $H_2C{=}CH_2$ (b) $HC{\equiv}CH$ (c) $H_2C{=}C{=}CH_2$ (d) $H_3C{-}CH_3$

7. The C-2 epimer of D-glucose is

(a) D-Mannose (b) D-Fructose (c) D-Galactose (d) D-Gulose

8. The value of integral $\int_{-2}^{+2} xe^{-2x^2}\,dx$ is

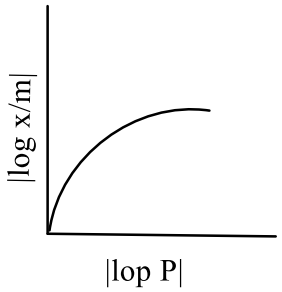
(a) 0 (b) $\frac{1}{2}$ (c) 1 (d) 2

9. The number of crystal systems and the number of Bravais lattices are, respectively,

(a) 14 and 7 (b) 7 and 32 (c) 32 and 14 (d) 7 and 14

10. For adsorption of a gas on a solid surface, the plot that represents Freundlich isotherm is (x = mass of gas, m = mass of adsorbent, P = pressure)

(a)



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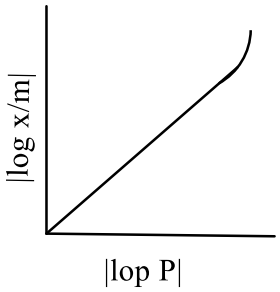

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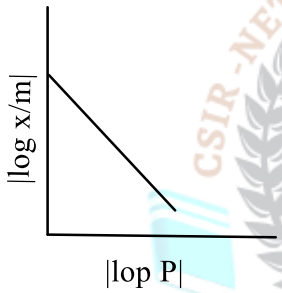

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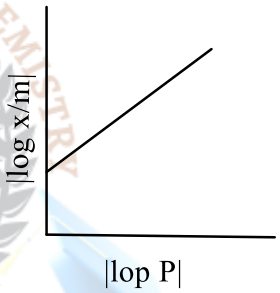


Attempt ALL the questions. Q.11 – Q.30 Multiple Choice Question (MCQ), carry TWO mark each (for each wrong answer: – 2/3).

11. With respect to periodic properties, the CORRECT statement is

(a) Electron affinity order is F > O > Cl

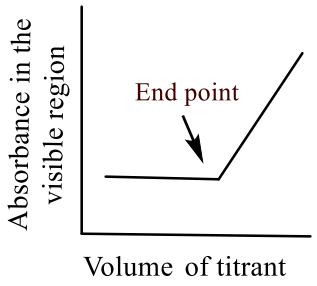
(b) First ionisation energy order is Al > Mg > K

(c) Atomic radius order is N > P > As

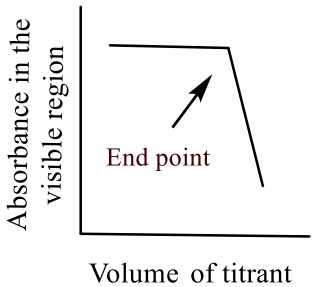
(d) Ionic radius order is $K^+ > Ca^{2+} > Mg^{2+}$

12. Which plot represents a spectrophotometric titration, where the titrant alone absorbs light in the visible region?

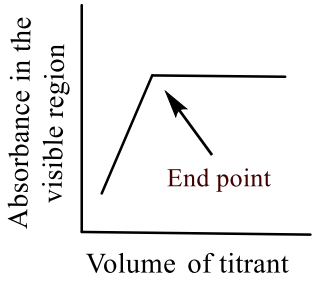
(a)



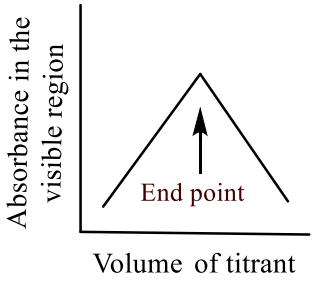
(b)



(c)



(d)



13. Among the following metal carbonyl species, the one with the highest metal-carbon back bonding is

(a) $[Ti(CO)_6]^{2-}$ (b) $[V(CO)_6]^{-}$ (c) $[Cr(CO)_6]$ (d) $[Mn(CO)_6]^{+}$

14. The CORRECT order of Δ_o (the octahedral crystal field splitting of d orbitals) values for the following anionic metal complexes is

(a) $[Ir(CN)_6]^{3-} < [Rh(CN)_6]^{3-} < [RhI_6]^{3-} < [CoI_6]^{3-}$

(b) $[CoI_6]^{3-} < [RhI_6]^{3-} < [Rh(CN)_6]^{3-} < [Ir(CN)_6]^{3-}$

(c) $[CoI_6]^{3-} < [Rh(CN)_6]^{3-} < [RhI_6]^{3-} < [Ir(CN)_6]^{3-}$

(d) $[Ir(CN)_6]^{3-} < [CoI_6]^{3-} < [Rh(CN)_6]^{3-} < [RhI_6]^{3-}$

15. The decay modes of ^{14}C and ^{14}O are

(a) β decay (b) positron emission

(c) β decay and positron emission (d) positron emission and β decay

16. Consider the following four xenon compounds: XeF_2, XeF_4, XeF_6 and XeO_3. The pair of xenon compounds expected to have non-zero dipole moment is

(a) XeF_4 and XeF_6 (b) XeF_2 and XeF_4 (c) XeF_2 and XeO_3 (d) XeF_6 and XeO_3

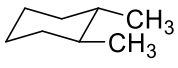
17. The CORRECT order of stability for the following carbocations is

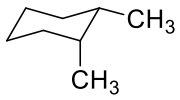
I **II** **III** **IV**

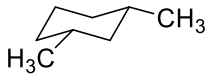
(a) I < III < IV < II (b) III < II < IV < I

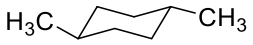
(c) II < IV < III < I (d) IV < III < I < II

18. Among the dimethylcyclohexanes, which one can be obtained in enantiopure form?

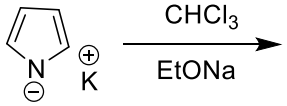
(a) 

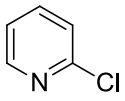
(b) 

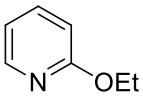
(c) 

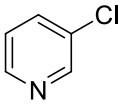
(d) 

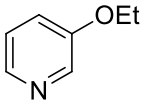
19. The major product formed in the following reaction is



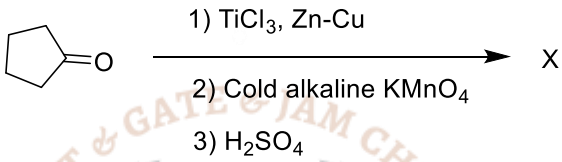
(a) 

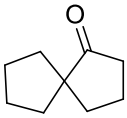
(b) 

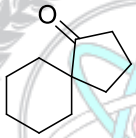
(c) 

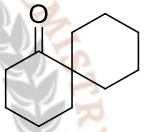
(d) 

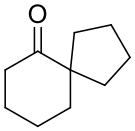
20. The product X in the following reaction sequence is



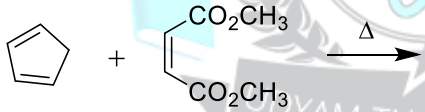
(a) 

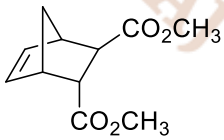
(b) 

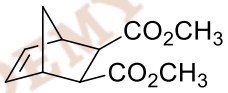
(c) 

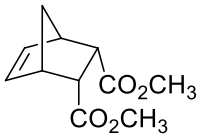
(d) 

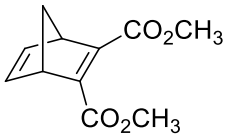
21. The major product formed in the following reaction is



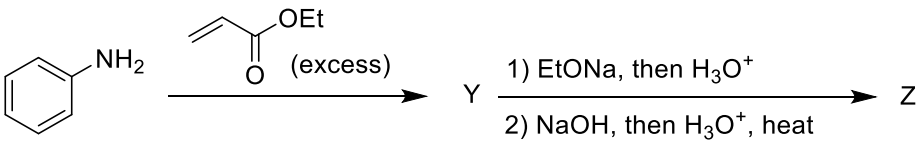
(a) 

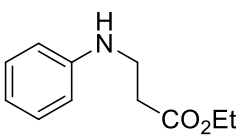
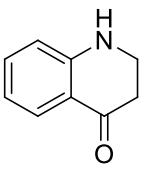
(b) 

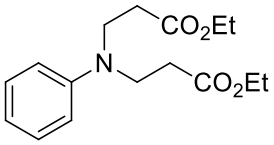
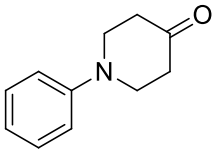
(c) 

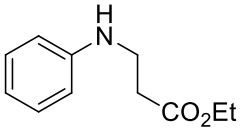
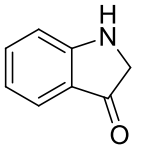
(d) 

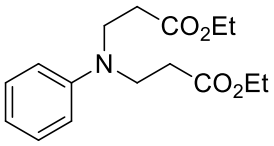
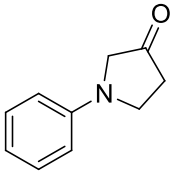
22. The major products Y and Z in the following reaction sequence are



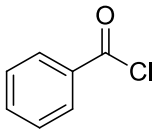
(a) Y =  ; Z = 

(b) Y =  ; Z = 

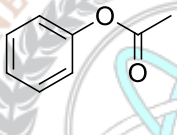
(c) Y =  ; Z = 

(d) Y =  ; Z = 

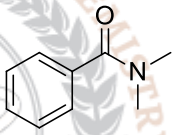
23. The CORRECT order of carbonyl stretching frequencies for the following compounds is



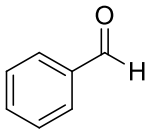
I



II



III

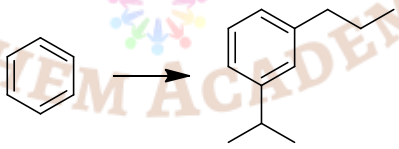


IV

(a) II < I < III < IV (b) I < III < II < IV

(c) IV < II < III < I (d) III < IV < II < I

24. The sequence of three steps involved in the following conversion is



(a) (i) = Friedel-Crafts alkylation (b) (i) = Friedel-Crafts acylation

(ii) = Reduction (ii) = Friedel-Crafts alkylation

(iii) = Friedel-Crafts acylation (iii) = Reduction

(c) (i) = Friedel-Crafts acylation (d) (i) = Friedel-Crafts alkylation

(ii) = Reduction (ii) = Friedel-Crafts acylation

(iii) = Friedel-Crafts alkylation (iii) = Reduction

25. The CORRECT expression that corresponds to reversible and adiabatic expansion of an ideal gas is

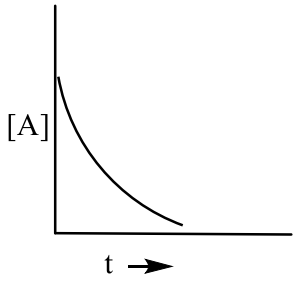
(a) $\Delta U = 0$ (b) $\Delta H = 0$ (c) $\Delta S = 0$ (d) $\Delta G = 0$

26. The electrolyte AB_2 ionises in water as, $AB_2 \rightleftharpoons A^{2+} + 2B^-$. The mean ionic activity coefficient ($\gamma_\pm$) is

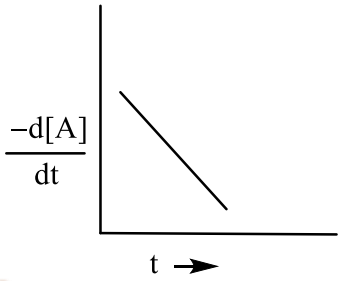
(a) $\gamma_{A^{2+}}^{\frac{1}{2}}\gamma_{B^-}$ (b) $\gamma_{A^{2+}}^{\frac{1}{2}}\gamma_{B^-}^{\frac{2}{3}}$ (c) $\gamma_{A^{2+}}^{\frac{2}{3}}\gamma_{B^-}^{\frac{1}{3}}$ (d) $(\gamma_{A^{2+}} + 2\gamma_{B^-})^{\frac{1}{2}}$

27. The reaction, $A \longrightarrow$ Products, follows first-order kinetics. If [A] represents the concentration of reactant at time t, the INCORRECT variation is shown in

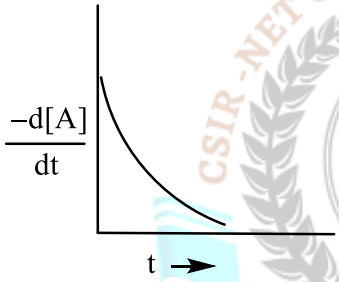
(a)



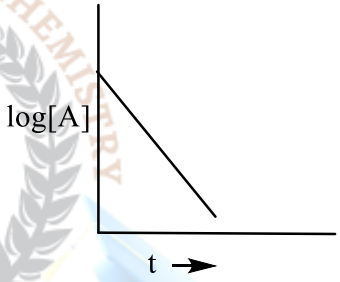
(b)



(c)



(d)



28. The behavior of Cl_2 is closest to ideal gas behavior at

(a) 100 °C and 10.0 atm (b) 0 °C and 0.50 atm

(c) 200 °C and 0.50 atm (d) −100 °C and 10.0 atm

29. A vector $\vec{A} = \vec{\imath} + x\vec{\jmath} + 3\vec{k}$ is rotated through an angle and is also doubled in magnitude resulting in $\vec{B} = 4\vec{\imath} + (4x - 2)\vec{\jmath} + 2\vec{k}$. An acceptable value of x is

(a) 1 (b) 2 (c) 3 (d) $\frac{4}{3}$

30. With reference to the variation of molar conductivity (Λ_m) with concentration for a strong electrolyte in an aqueous solution, the CORRECT statement is

(a) The asymmetry effect contributes to decrease Λ_m whereas the electrophoretic effect contributes to increase Λ_m

(b) The asymmetry effect contributes to increase Λ_m whereas the electrophoretic effect contributes to decrease Λ_m

(c) Both asymmetry effect and electrophoretic effect contribute to decrease Λ_m

(d) Both asymmetry effect and electrophoretic effect contribute to increase Λ_m

Attempt ALL the questions. Q.31 – Q.40 Multiple Select Question (MSQ), carry TWO mark each (no negative marks).

31. **Which of the following metal(s) is (are) extracted from its(their) sulfide ore(s) by self-reduction/air reduction method?**

(a) Cu (b) Al (c) Au (d) Pb

32. **In a saturated calomel electrode, the saturation is with respect to**

(a) KCl (b) Hg_2Cl_2 (c) $HgCl_2$ (d) AgCl

33. **Consider the following six solid binary oxides: $CaO, Al_2O_3, PbO, Cs_2O, SiO_2$ and Sb_2O_3.The pair(s) of ionic oxides is (are)**

(a) CaO and Al_2O_3 (b) CaO and PbO (c) Cs_2O and Al_2O_3 (d) SiO_2 and Sb_2O_3

34. **Choose the CORRECT answer(s) with respect to the magnesium-EDTA titration carried out in the pH range 7 – 10. 5 , using Solochrome black as indicator**

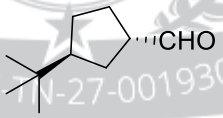
(a) Magnesium–indicator complex is more stable than the magnesium-EDTA complex

(b) At the end point, the colour changes from red to blue

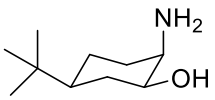
(c) After the end point, the colour of the solution is due to the indicator

(d) pH range of 7 – 10.5 is necessary for observing the specific colour change

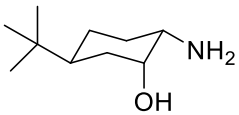
35. **On reaction with $NaNO_2$ and HCl, which of the following amino alcohol(s) will yield compound P?**

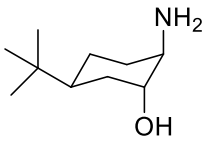


P

(a) 

(b) 

(c) 

(d) 

36. **The CORRECT statement(s) about carbene is (are)**

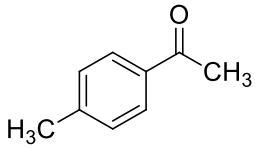
(a) Carbene is a neutral species

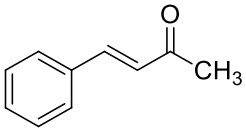
(b) Carbene is an intermediate in the Curtius rearrangement

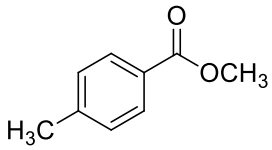
(c) Carbene can insert into both σ and π-bonds

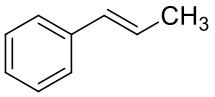
(d) Carbene is generated from amines on reaction with nitrous acid

37. **The compound(s) that shows (show) positive haloform test is(are)**

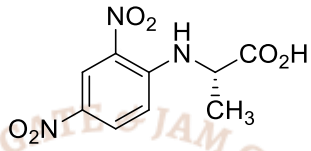
(a) 

(b) 

(c) 

(d) 

38. Tetrapeptide(s) that gives (give) the following product on reaction with Sanger's reagent followed by hydrolysis is (are)



(a) Ala-Gly-Leu-Phe (b) Asp-Phe-Leu-Pro (c) Asp-Gly-Tyr-Phe (d) Ala-Phe-Tyr-Pro

39. Which of the following set(s) of quantum numbers is(are) NOT allowed?

(a) $n = 3, l = 2, m_l = -1$ (b) $n = 4, l = 0, m_l = -1$

(c) $n = 3, l = 3, m_l = -3$ (d) $n = 5, l = 3, m_l = +2$

40. The CORRECT expression(s) for isothermal expansion of 1 mol of an ideal gas is(are)

(a) $\Delta A = RT \ln \frac{V_{initial}}{V_{final}}$ (b) $\Delta G = RT \ln \frac{V_{initial}}{V_{final}}$

(c) $\Delta H = RT \ln \frac{V_{final}}{V_{initial}}$ (d) $\Delta S = RT \ln \frac{V_{final}}{V_{initial}}$

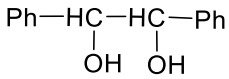
Attempt ALL the questions. Q.41 – Q.50 Numerical Answer Type (NAT), carry ONE mark each (no negative marks).

41. The number of possible isomers for $[Pt(py)(NH_3)BrCl]$ is_____. (py is pyridine)

42. The volume of 0.3 M ferrous ammonium sulphate solution required for the completion of redox titration with 20 mL of 0.1 M potassium dichromate solution is _____mL.

43. Among the following hydrocarbon(s), how many of them would give rise to three groups of proton NMR peaks with 2 : 2 : 3 integration ratio?

44. The number of stereoisomers possible for the following compound is_____.



45. The number of hydrogen bond(s) present in a guanine-cytosine base pair is _____.

46. The time for 50 % completion of a zero-order reaction is 30 min. Time for 80 % completion of this reaction is _____min.

47. Consider the reaction $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$

The value of ΔU for the reaction at 300 K is -281.8 kJ mol^{-1}. The value of ΔH at same temperature is_____ kJ mol^{-1}. (rounded up to the first decimal place).

[$R = 8.3$ JK^{-1} mol^{-1}]

48. The nuclear spin quantum number (I) of a nucleus is $\frac{3}{2}$. When placed in an external magnetic field, the number of possible spin energy states it can occupy is_____.

49. The value of C_v for 1 mol of N_2 gas predicted from the principle of equipartition of energy, ignoring vibrational contribution, is_____ JK^{-1} mol^{-1}. (rounded up to two decimal places).

[$R = 8.3$ JK^{-1} mol^{-1}]

50. Assuming ideal gas behavior, the density of O_2 gas at 300 K and 1.0 atm is_____ g L^{-1}. (rounded up to two decimal places).

[$R = 0.082$ L atm mol^{-1} K^{-1}, molar mass of $O_2 = 32$]

Attempt ALL the questions. Q.51 – Q.60 Numerical Answer Type (NAT), carry TWO marks each (no negative marks).

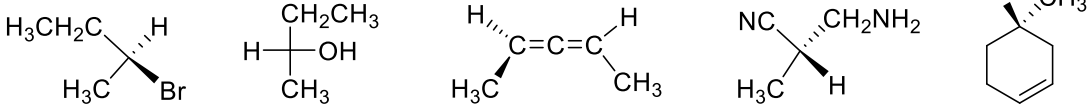
51. How many of the following interhalogen species have 2 lone pairs of electrons on the central atom_____ {ClF_3, ClF_2^-, ClF_5 and ICl_2^+}

52. ^{24}Na decays to one-fourth of its initial amount in 29.8 hours. Its decay constant is_____ $hour^{-1}$. (rounded up to four decimal places).

53. The magnitude of crystal field stabilization energy (CFSE) of octahedral $[Ti(H_2O)_6]^{3+}$ complex is 7680 cm^{-1}. The wavelength at the maximum absorption (λ_{max}) of this complex is_____nm (rounded up to the nearest integer).

54. Elemental analysis of an organic compound containing C, H and O gives percentage composition: C: 39.9 % and H: 6.7 %. If the molecular weight of the compound is 180, the number of carbon atoms present in the molecule is_____.

55. The number of compounds having S-configuration among the following is_____.



56. The emf of a standard cadmium cell is 1.02 V at 300 K. The temperature

coefficient of the cell is $-5.0 \times 10^{-5}\ V\ K^{-1}$. The value of ΔH° for the cell is_____kJ mol^{-1} (rounded up to two decimal places). [$1F = 96500\ C\ mol^{-1}$]

57. For the reaction $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(liq)$, $\Delta\bar{S}^{o}_{universe}$ for the reaction is _____ $JK^{-1}mol^{-1}$.

$\bar{S}^{o}_{H_2O}(liq) = 70\ JK^{-1}\ mol^{-1}$; $T = 300\ K$

$\bar{S}^{o}_{O_2}(g) = 204\ JK^{-1}\ mol^{-1}$; $\Delta\bar{H}^{o} = -285\ kJ\ mol^{-1}$

$\bar{S}^{o}_{H_2}(g) = 130\ JK^{-1}\ mol^{-1}$;

58. For H_2 molecule, the fundamental vibrational frequency ($\bar{\upsilon}_e$) can be taken as 4400 cm^{-1}. The zero-point energy of the molecule is_____ kJ mol^{-1}. (rounded up to two decimal). [$h = 6.6 \times 10^{-34}\ J\ s, c = 3 \times 10^{8}\ m\ s^{-1}, N_A = 6 \times 10^{23}\ mol^{-1}$]

59. The solubility of PbI_2 in 0.10 M KI (aq) is_____$\times 10^{-7}$ M (rounded up to two decimal places). [The solubility product, $K_{sp} = 7.1 \times 10^{-9}$]

60. The electron of a hydrogen atom is in its n^{th} Bohr orbit having de Broglie wavelength of 13.4 Å. The value of n is_____(rounded up to the nearest integer). [Radius of n^{th}Bohr orbit $= 0.53\ n^2$ Å, $\pi = 3.14$]

Answer Key

Q.No	Ans		Q.No	Ans		Q.No	Ans
1.	a		21.	c		41.	3 to 3
2.	a		22.	b		42.	40 to 40
3.	a		23.	d		43.	2 to 2
4.	b		24.	b		44.	3 to 3
5.	c		25.	c		45.	3 to 3
6.	b		26.	**		46.	48 to 48
7.	a		27.	b		47.	–286.0 to –282.0
8.	a		28.	c		48.	4 to 4
9.	d		29.	b		49.	20.00 to 21.00
10.	d		30.	c		50.	1.29 to 1.31
11.	d		31.	a & d		51.	2 to 2
12.	a		32.	a & b		52.	0.0460 to 0.0470
13.	a		33.	a & c		53.	520 to 521
14.	b		34.	b & c & d		54.	6 to 6
15.	c		35.	b & c		55.	4 to 4
16.	d		36.	a & c		56.	–201.00 to –198.00
17.	c		37.	a & b		57.	786 to 790
18.	a		38.	a & d		58.	25.80 to 26.40

19.	c		39.	b & c		59.	7.0 to 7.2
20.	d		40.	a & b & d		60.	4 to 4

Q. 1 – 10	1 Mark (MCQ)					Q. 41 – 50	1 Mark (NAT)
Q. 11 – 30	2 Mark (MCQ)		Q. 31 – 40	2 Mark (MSQ)		Q. 51 – 60	2 Mark (NAT)