JEE-MAIN – JUNE, 2022

(Held On Tuesday 26th June, 2022) **TIME : 3 : 00 PM to 6 : 00 PM**

Chemistry

Test Pattern : JEE-MAIN **Maximum Marks : 120**

Topic Covered: FULL SYLLABUS

Important instruction:

1. Use Blue / Black Ball point pen only.
2. There are three sections of equal weightage in the question paper **Physics, Chemistry** and **Mathematics** having 30 questions in each subject. Each paper have 2 sections A and B.
3. You are awarded +4 marks for each correct answer and –1 marks for each incorrect answer.
4. Use of calculator and other electronic devices is not allowed during the exam.
5. No extra sheets will be provided for any kind of work.

Name of the Candidate (in Capitals) _____

Father's Name (in Capitals) _____

Form Number : in figures _____

: in words _____

Centre of Examination (in Capitals): _____

Candidate's Signature: _____ Invigilator's Signature : _____

Rough Space

YOUR TARGET IS TO SECURE GOOD RANK IN JEE-MAIN

FINAL JEE–MAIN EXAMINATION – JUNE, 2022

(Held On Sunday 26th June, 2022) **TIME : 3 : 00 PM to 6 : 00 PM**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

1. The number of radial and angular nodes in 4d orbital are. respectively

(A) 1 and 2 (B) 3 and 2

(C) 1 and 0 (D) 2 and 1

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Radial node = $n - l - 1$

$= 4 - 2 - 1$

$= 1$

Angular node (l) = 2

2. Match List I with List II.

List I Enzyme	List II Conversion of
A. Invertase	I. Starch into maltose
B. Zymase	II. Maltose into glucose
C. Diastase	III. Glucose into ethanol
D. Maltase	IV. Cane sugar into glucose

Choose the most appropriate answer from the options given below :

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

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

(C) A-IV, B-IIL C-I. D-II

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

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Invertase : Cane sugar → Glucose and fructose

Zymase : Glucose → Ethanol and CO_2

Diastase : Starch → Maltose

Maltase : Maltose → Glucose

3. Which of the following elements in considered as a metalloid?

(A) Sc (B) Pb (C) Bi (D) Te

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Sc, Pb, Bi are metals

Te is a metalloid

4. The role of depressants in Froth Flotation method* is to

(A) selectively prevent one component of the ore from coming to the froth.

(B) reduce the consumption of oil for froth formation.

(C) stabilize the froth.

(D) enhance non-wettability of the mineral particles.

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Depressant prevent one component from coming to the froth.

For eg., in Galena ore, the depressant (NaCN) prevents impurity (ZnS) from coming to the froth.

5. Boiling of hard water is helpful in removing the temporary hardness by converting calcium hydrogen carbonate and magnesium hydrogen carbonate to

(A) $CaCO_3$ and $Mg(OH)_2$

(B) $CaCO_3$ and M_2CO_3

(C) $Ca(OH)_2$ and $MgCO_3$

(D) $Ca(OH)_2$ and $Mg(OH)_2$

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. $Mg(HCO_3)_2 \xrightarrow{\text{Boil}} Mg(OH)_2 + 2CO_2\uparrow$

$Ca(HCO_3)_2 \xrightarrow{\text{Boil}} CaCO_3 + H_2O + CO_2\uparrow$

6. s-block element which cannot be qualitatively confirmed by the flame test is

(A) Li (B) Na (C) Rb (D) Be

Official Ans. by NTA (D)

Allen Ans. (D)

Sol.

	Flame color
Li	Crimson Red
Na	Yellow
Rb	Red violet
Be	No color

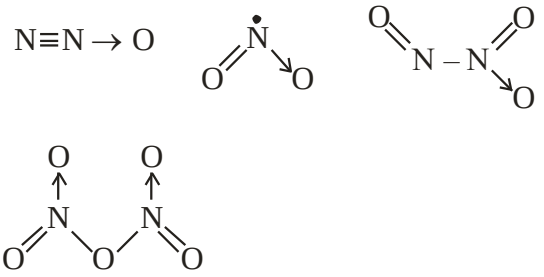
7. The oxide which contains an odd electron at the nitrogen atom is

(A) N_2O (B) NO_2 (C) N_2O_3 (D) N_2O_5

Official Ans. by NTA (B)

Allen Ans. (B)

Sol.



8. Which one of the following is an example of disproportionation reaction?

(A) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

(B) $MnO_4^{2-} + 4H^+ + 4e^- \rightarrow MnO_2 + 2H_2O$

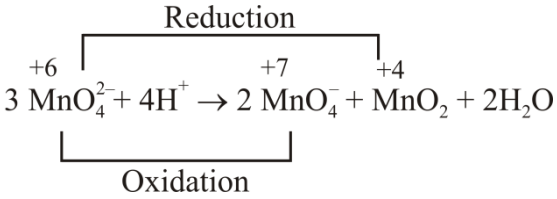
(C) $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$

(D) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.



9. The most common oxidation state of Lanthanoid elements is +3. Which of the following is likely to deviate easily from +3 oxidation state?

(A) Ce (At. No. 58) (B) La (At. No. 57)

(C) Lu (At. No. 71) (D) Gd (At. No. 64)

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Ce = [Xe] $4f^1\ 5d^1\ 6s^2$

Ce^{3+} = [Xe] $4f^1\ 5d^0$

Ce^{+4} = [Xe] $4f^0\ 5d^0$ (Noble gas configuration)

10. The measured BOD values for four different water samples (A-D) are as follows:

A = 3 ppm: B=18 ppm: C-21 ppm: D=4 ppm. The water samples which can be called as highly polluted with organic wastes, are

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

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

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Clean water $\longrightarrow$ B.O.D. < 5 ppm

Highly polluted water $\longrightarrow$ B.O.D. > 17 ppm

11. The correct order of nucleophilicity is

(A) $F^- > OH^-$ (B) $H_2\ddot{O} > OH^-$

(C) $R\ddot{O}H > RO^-$ (D) $NH_2^- > NH_3$

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Nucleophilicity $\propto$ electro density on donor atom

$\propto$ size of donor atom (in gas)

$\propto \dfrac{1}{\text{EN of atom}}$ (for period)

12. Oxidation of toluene to Benzaldehyde can be easily carried out with which of the following reagents?

(A) CrO_3/acetic acid, H_3O^+

(B) CrO_3/acetic anhydride, H_3O^+

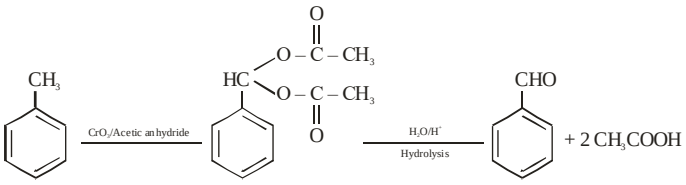
(C) $KMnO_4$/HCl, H_3O^+

(D) CO/HCl, anhydrous $AlCl_3$

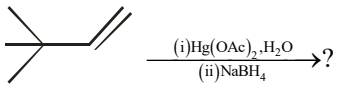
Official Ans. by NTA (B)

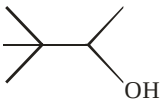
Allen Ans. (B)

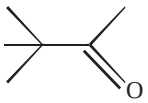
Sol.

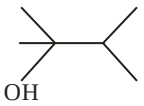


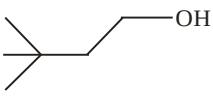
13. The major product in the following reaction



(A) 

(B) 

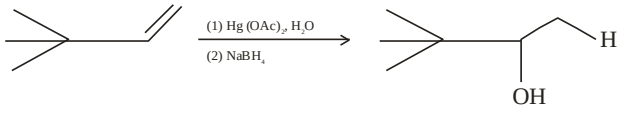
(C) 

(D) 

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.

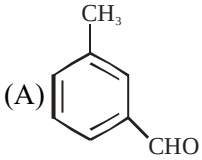


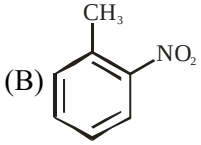
Oxymercuration – Demercuration

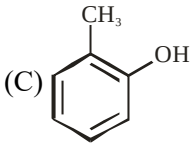
Addition of H_2O

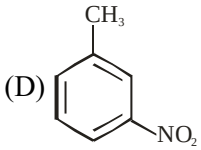
Markovnikov's addition without rearrangement

14. Halogenation of which one of the following will yield m-substituted product with respect to methyl group as a major product?

(A) 

(B) 

(C) 

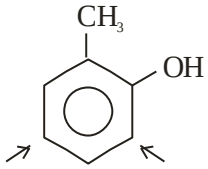
(D) 

Official Ans. by NTA (C)

Allen Ans. (C)

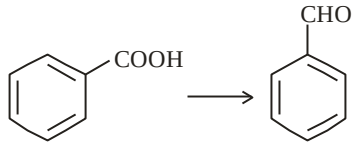
Sol. Electrophile will attack at ortho and para position with respect to better electron releasing group (ERG)

ERG : $-OH > -CH_3$



Para position with respect to – OH (+R) group and it will be meta position with respect to $-CH_3$ group.

15. The reagent, from the following, which converts benzoic acid to benzaldehyde in one step is



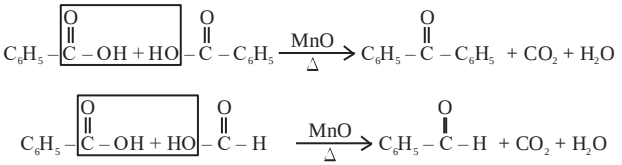
(A) $LiAlH_4$ (B) $KMnO_4$

(C) MnO (D) $NaBH_4$

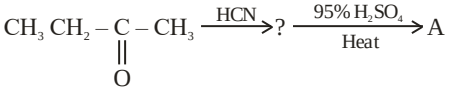
Official Ans. by NTA (C)

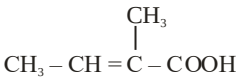
Allen Ans. (D)

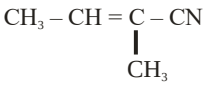
Sol.

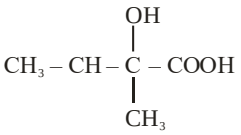


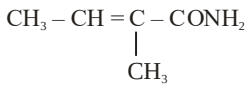
16. The final product 'A' in the following reaction sequence



(A) 

(B) 

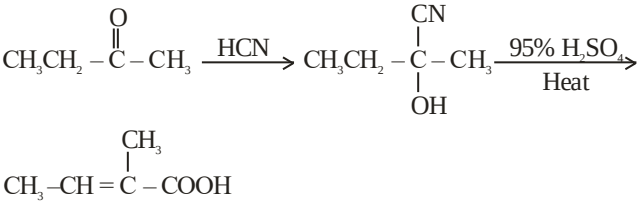
(C) 

(D) 

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.



17. Which statement is NOT correct for p-toluenesulphonyl chloride?

(A) It is known as Hinsberg's reagent.

(B) It is used to distinguish primary and secondary amines.

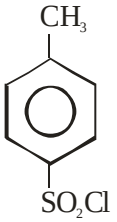
(C) On treatment with secondary amine, it leads to a product, that is soluble in alkali.

(D) It doesn't react with tertiary amines.

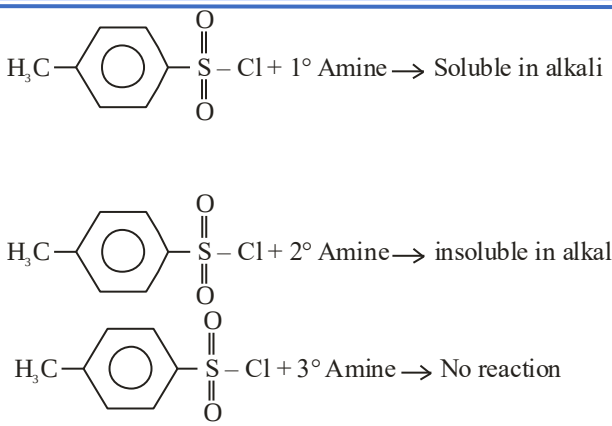
Official Ans. by NTA (C)

Allen Ans. (C)

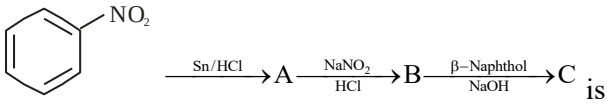
Sol.



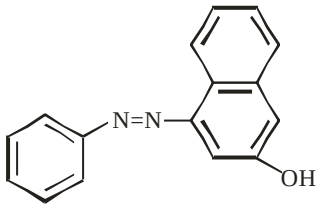
Hinsberg's reagent

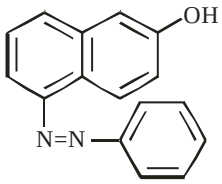


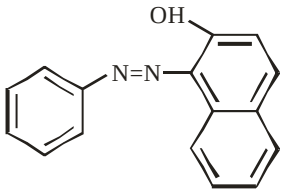
18. The final product 'C' is the following series series of reactions

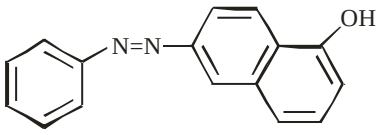


is

(A) 

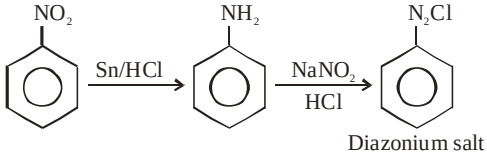
(B) 

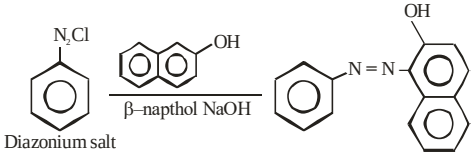
(C) 

(D) 

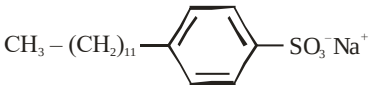
Official Ans. by NTA (C)

Allen Ans. (D)

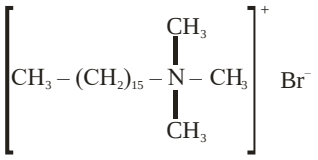
Sol. 



19. Which of the following is NOT an example of synthetic detergent?

(A) 

(B) $CH_3 - (CH_2)_{16} - COO^- Na^+$

(C) 

(D) $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Refer NCERT (Page No. 452)

20. Which one of the following is a water soluble vitamin, that is not excreted easily?

(A) Vitamin B_2 (B) Vitamin B_1

(C) Vitamin B_6 (D) Vitamin B_{12}

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Refer NCERT (Page No. 426)

SECTION-B

1. CNG is an important transportation fuel. When 100 g CNG is mixed with 208 oxygen in vehicles, it leads to the formation of CO_2 and H_2O and produces large quantity of heat during this combustion, then the amount of carbon dioxide, produced in grams is_____. [nearest integer]

[Assume CNG to be methane]

Official Ans. by NTA (143)

Allen Ans. (143)

Sol. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Mole $\quad \frac{100}{16} \quad \frac{208}{32}$

$= 6.25 \quad = 6.5$

$\frac{\text{Mole}}{\text{Stoi. Coeff.}} \quad \frac{6.25}{1} \quad \frac{6.5}{2} = 3.25$

So, O_2 is limiting reagent

Mole – Mole analysis

$$\frac{n_{O_2}}{2} = \frac{n_{co_2}}{1}$$

$$\frac{6.5}{2} = n_{co_2}$$

Mass of $CO_2 = \frac{6.5}{2} \times 44 = 143$ gm

2. In a solid AB. A atoms are in ccp arrangement and B atoms occupy all the octahedral sites. If two atoms from the opposite faces are removed, then the resultant stoichiometry of the compound is A_xB_y. The value of x is_____. [nearest integer]

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $A \rightarrow 4 - \left(2 \times \frac{1}{2}\right) = 3$

$B \rightarrow 12 \times \frac{1}{4} + 1 \times 1 = 4$

So, Compound is A_3B_4

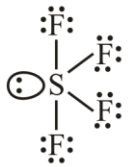
The value of x is 3.

3. Amongst SF_4, XeF_4, CF_4 and H_2O, the number of species with two lone pairs of electrons _____ .

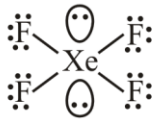
Official Ans. by NTA (3)

Allen Ans. (1)

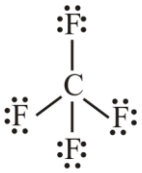
Sol.



Total lone pairs = 13

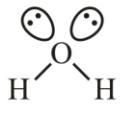


Total lone pairs = 14



Total lone pairs = 12

Total lone pairs = 2



4. A fish swimming in water body when taken out from the water body is covered with a film of water of weight 36 g. When it is subjected to cooking at 100°C, then the internal energy for vaporization in kJ mol^{-1} is _____.

[nearest integer]

[Assume steam to be an ideal gas. Given $A_{vap}H^{!}$ for water at 373 K and 1 bar is 41.1 kJ mol^{-1} ; R = 8.31 $JK^{-1}mol^{-1}$]

Official Ans. by NTA (38)

Allen Ans. (38)

Sol. $H_2O\ (l) \rightarrow H_2O(g)$

$n = \frac{36}{18} = 2$ mol

$\Delta U = \Delta H - \Delta n_g RT$

$= 41.1 - \frac{1 \times 8.31 \times 373}{1000}$ kJ / mol

$= 38$ kJ/mol

5. The osmotic pressure exerted by a solution prepared by dissolving 2.0 g of protein of molar mass 60 kg mol^{-1} in 200 mL of water at 27°C is _____ Pa. [integer value]

(use R = 0.083 L bar mol^{-1} K^{-1})

Official Ans. by NTA (415)

Allen Ans. (415)

Sol. $\pi = iCRT$

$= \frac{1 \times 2}{60000 \times 0.2} \times 0.083 \times 300$

$= 0.00415$ bar $\quad (\because\ 1 \text{ bar} = 10^5 \text{ Pa})$

So, 0.00415×10^5 Pa = 415 Pa

6. 40° of HI undergoes decomposition to H_2 and I_2 at 300 K. $\Delta G^{!}$ for this decompostion reaction at one atmosphere pressure is_____ J mol^{-1}. [nearest integer]

(Use R = 8.31 J K^{-1} mol^{-1}; log 2 = 0.3010. In 10 = 2.3, log 3 = 0.477)

Official Ans. by NTA (2735)

Allen Ans. (2735)

Sol. $HI \rightleftharpoons \frac{1}{2}H_2 + \frac{1}{2}I_2$

t_i	1		
teq	$1 - 0.4$	$\frac{0.4}{2}$	$\frac{0.4}{2}$

$K_p = \frac{(0.2)^{\frac{1}{2}}(0.2)^{\frac{1}{2}}}{1 - 0.4} = \frac{0.2}{0.6} = \frac{1}{3}$

$\Delta G = \Delta G^\circ + RT\ \ln K = 0$

$\Delta G^\circ = -RT\ \ln K \Rightarrow -8.31 \times 300 \times 2.3 \times \log\left(\frac{1}{3}\right)$

$= 2735$ J/mol

7. $Cu(s) + Sn^{2+}(0.001M) \rightarrow Cu^{2+}(0.01M) + Sn(s)$

The Gibbs free energy change for the above reaction at 298 K is $x \times 10^{-1}$ kJ mol^{-1};

The value of x is_____. [nearest integer]

$\left[\text{Given}: E^\square_{Cu^{2+}/Cu} = 0.34V; E^\square_{Sn^{2+}/Sn} = -0.14V; F = 96500C\ mol^{-1}\right]$

Official Ans. by NTA (983)

Allen Ans. (983)

Sol. $Cu_{(s)} + Sn^{2+}(0.001\ M) \rightarrow Cu^{2+}(0.01\ M) + Sn_{(s)}$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= -0.14 - (0.34)$

$= -0.48$ V

$E_{cell} = E^\circ_{cell} - \frac{0.059}{2}\log\frac{[Cu^{2+}]}{[Sn^{2+}]}$

$= -0.48 - \frac{0.059}{2}\log\frac{0.01}{0.001}$

$= -0.509$

$\Delta G = -nF\ E_{cell}$

$= -2 \times 96500 \times (-0.5095)$

$= 98333.5$ J/mol

$= 98.335$ kJ/mol

$= 983.35 \times 10^{-1}$ kJ/mol

Nearest Integer : 983

8. Catalyst A reduces the activation energy for a reaction by 10 kJ mol^{-1} at 300 K. The ratio of rate constants, $\frac{k_{T,Catalysed}}{k_{T,Uncatalysed}}$ is e^x. The value of x is _____. [nearest integer]

[Assume theat the pre-exponential factor is same in both the cases.

Given R = 8.31 J K^{-1} mol^{-1}]

Official Ans. by NTA (4)

Allen Ans. (4)

Sol.

$K = Ae^{\frac{-Ea}{RT}}$

$K_{cat} = Ae^{-\frac{E_a^1}{RT}}, \quad K_{uncat.} = Ae^{-\frac{Ea}{RT}}$

$\frac{K_{cat}}{K_{uncat.}} = e^{\frac{E_a - E_a^1}{RT}} = e^{\frac{10\times1000}{8.31\times300}} = e^{4.009} = e^x$

$\therefore\ x = 4$

9. Reaction of $[Co(H_2O)_6]^{2+}$ with excess ammonia and in the presence of oxygen results into a diamagnetic product. Number of electrons present in t_{2g}–orbitals of the product is _____ .

Official Ans. by NTA (6)

Allen Ans. (6)

Sol. $[Co(H_2O)_6]^{2+} + NH_3(excess) \rightarrow [Co(NH_3)_6]^{3+} + 6H_2O$

Diamagnetic

↓

Low spin complex

$Co^{3+} \Rightarrow 3d^6\ 4s^0$

$\Rightarrow t_{2g}^6\ e_g^0$

Total number electrons = 6

10. The moles of methane required to produce 81 g of water after complete combustion is _____ $\times 10^{-2}$ mol. [nearest integer]

Official Ans. by NTA (225)

Allen Ans. (225)

Sol. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

POAC on H atom

$n_{CH4} \times 4 = n_{H2O} \times 2$

$n_{CH_4} = \frac{81}{18} \times 2 \times \frac{1}{4} = \frac{81}{36}$

$n_{CH_4} = 2.25$

$= 225 \times 10^{-2}$

Nearest Integers = 225