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JEE (ADVANCED) 2020

DATE: 27-09-2020

Questions & Solutions

PAPER-2 | SUBJECT : CHEMISTRY

PAPER-2 : INSTRUCTIONS TO CANDIDATES

- **Question Paper-2 has three (03) parts : Physics, Chemistry and Mathematics.**
- Each part has a total of **eighteen (18) questions** divided into **three (03) sections (Section-1, Section-2 and Section-3).**
- Total number of questions in **Question Paper-2** are **: Fifty Four (54)** and Maximum Marks are **One Hundred Ninety Eight (198).**

Type of Questions and Marking Schemes

SECTION-1 (Maximum Marks: 18)

- This section contains **SIX (06)** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER ranging from 0 to 9, BOTH INCLUSIVE.**
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer. .
- Answer to each question will be evaluated according to the following marking scheme :

Full Marks : **+3** If ONLY the correct numerical value is entered.
Zero Marks : 0 If the question is unanswered.
Negative Marks : **–1** In all other cases.

SECTION 2 (Maximum Marks: 24)

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
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Partial Marks : **+3** If all the four options are correct but ONLY three options are chosen.
Partial Marks : **+2** If three or more options are correct but ONLY two options are chosen and both of which are correct.
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SECTION 3 (Maximum Marks : 24)

- This section contains **SIX (06)** questions. The answer to each question is a **NUMERICAL VALUE**.
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CHEMISTRY

SECTION 1 (Maximum Marks : 18)

- This section contains **SIX (06)** questions.
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1. The 1ST , 2nd, and the 3rd ionization enthalpies, I_1, I_2, and I_3, of four atoms with atomic numbers n, $n + 1$, $n + 2$, and $n + 3$, where $n < 10$, are tabulated below. What is the value of n ?

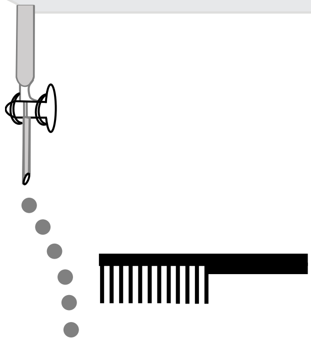
Atomic number	Ionization Enthalpy (kJ/mol)		
	I_1	I_2	I_3
n	1681	3374	6050
$n + 1$	2081	3952	6122
$n + 2$	496	4562	6910
$n + 3$	738	1451	7733

Ans. **(9)**

Sol. From given data (n+2) atom is alkali metal which is sodium.

As n +2 = 11 so $\boxed{n = 9}$

2. Consider the following compounds in the liquid form:
O_2, HF, H_2O, NH_3, H_2O_2, CCl_4, $CHCl_3$, C_6H_6, C_6H_5Cl.
When a charged comb is brought near their flowing stream, how many of them show deflection as per the following figure?



Ans. **(6)**

Sol. Polar compound show deflection by charged comb
So HF, H_2O, NH_3, H_2O_2, $CHCl_3$, C_6H_5Cl shows deflection by charged comb.

3. In the chemical reaction between stoichiometric quantities of $KMnO_4$ and KI in weakly basic solution, what is the number of moles of I_2 released for 4 moles of $KMnO_4$ consumed?

Ans. **(6)**

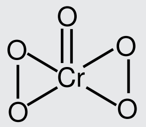
Sol. $\underset{4\text{ mole}}{2MnO_4^-} + 6I^- \longrightarrow \underset{6\text{mole}}{3I_2} + 2MnO_2$

4. An acidified solution of potassium chromate was layered with an equal volume of amyl alcohol. When it was shaken after the addition of 1 mL of 3% H_2O_2, a blue alcohol layer was obtained. The blue color is due to the formation of a chromium (VI) compound '**X**'. What is the number of oxygen atoms bonded to chromium through only single bonds in a molecule of **X**?

Ans. **(4)**

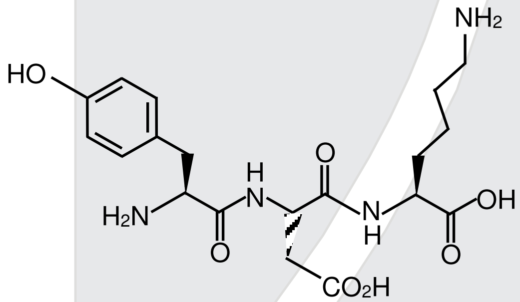
Sol. $K_2CrO_4 \xrightarrow{H^+/H_2O_2} CrO_5$

(Deep Blue solution)

$CrO_5 \Rightarrow$ 

No. of oxygen atom bonded with chromium with single bond is (4)

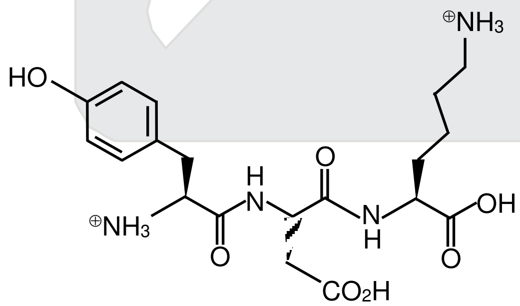
5. The structure of a peptide is given below.



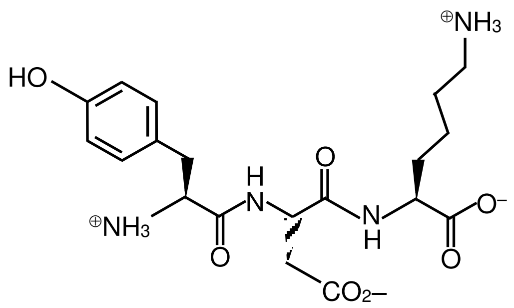
If the absolute values of the net charge of the peptide at pH = 2, pH = 6, and pH = 11 are $|z_1|$, $|z_2|$, and $|z_3|$, respectively, then what is $|z_1| + |z_2| + |z_3|$?

Ans. **(5)**

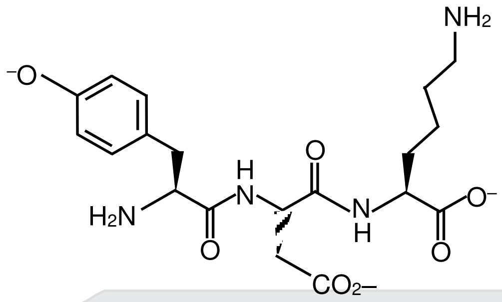
Sol. The structure of tripeptide will be as followed at PH = 2 (in highly acidic medium)



hence $|z_1| = 2$ at pH = 6 (in approximately neutral solution it will be



Hence $|z_2| = 0$ at pH =11 (in highly basic medium) the structure will be

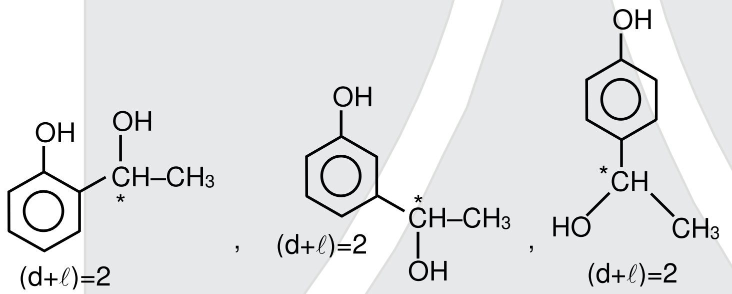


Hence $|z_3|$ will be 3.
Therefore $|z_1| + |z_2| + |z_3| = 2 + 0 + 3 = 5$

6. An organic compound ($C_8H_{10}O_2$) rotates plane-polarized light. It produces pink color with neutral $FeCl_3$ solution. What is the total number of all the possible isomers for this compound?

Ans. **(6)**

Sol. Since compound $C_8H_{10}O_2$ corresponds positively to neutral $FeCl_3$ hence it will be a phenolic compound the possible structures which are optically active are as followed



hence total optically active isomers will be 6.

SECTION 2 (Maximum Marks : 24)

- This section contains **SIX (06)** questions.
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- For each question, choose the option(s) corresponding to (all) the correct answer(s).
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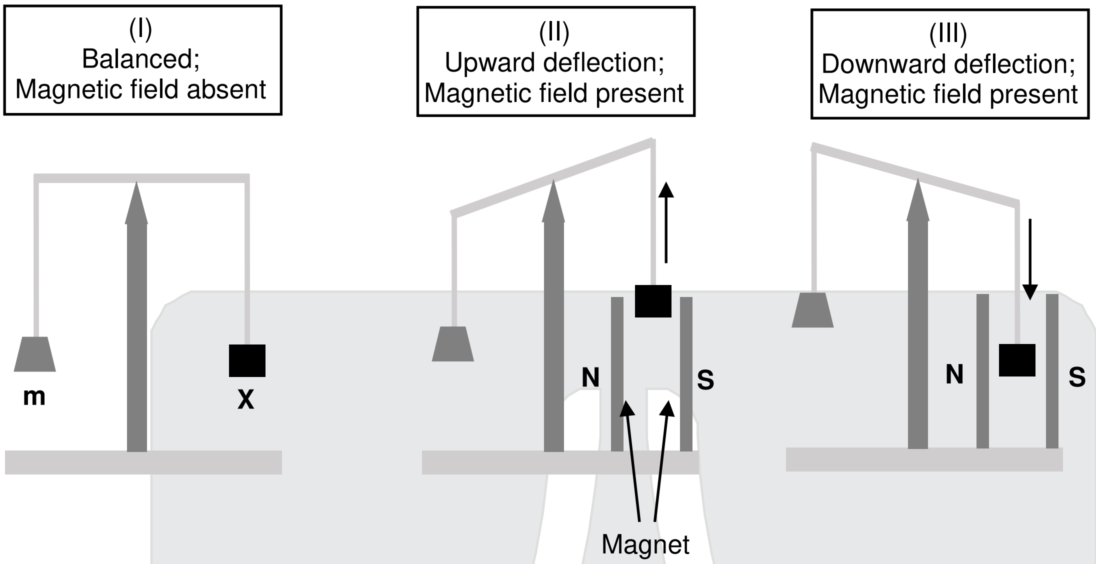
Negative Marks	: **–1** In all other cases.

7. In an experiment, m grams of a compound **X** (gas/liquid/solid) taken in a container is loaded in a balance as shown in figure **I** below. In the presence of a magnetic field, the pan with **X** is either deflected upwards (figure **II**), or deflected downwards (figure **III**), depending on the compound **X**. Identify the correct statement(s).



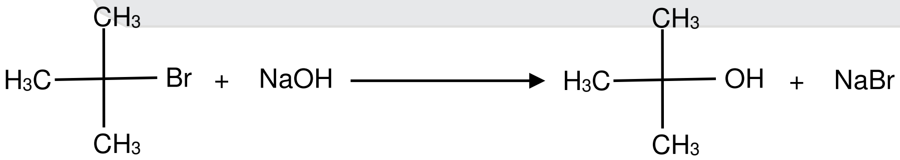
(A) If **X** is $H_2O(l)$, deflection of the pan is upwards.
(B) If **X** is $K_4[Fe(CN)_6](s)$, deflection of the pan is upwards.
(C) If **X** is $O_2\,(g)$, deflection of the pan is downwards.
(D) If **X** is $C_6H_6(l)$, deflection of the pan is downwards

Ans. **(ABC)**

Sol. Paramagnetic substance attracted by magnetic field so magnetic balance show downward deflection. While diamagnetic substance show repulsion in magnetic field show magnetic balance show upward deflection

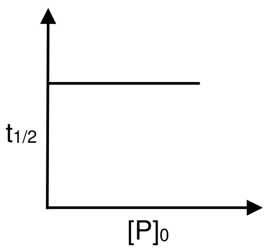
	Compound	Magnetic Nature	Deflection
(a)	H_2O	Diamagnetic	Upward
(b)	$K_4[Fe(CN)_6]$	Diamagnetic	Upward
(c)	$O_2\,(g)$	Paramagnetic	Downward
(d)	C_6H_6	Diamagnetic	Upward

8. Which of the following plots is(are) correct for the given reaction?
($[P]_0$ is the initial concentration of **P**)

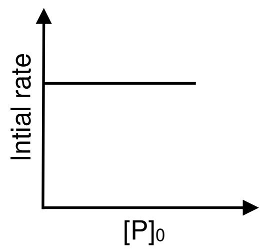


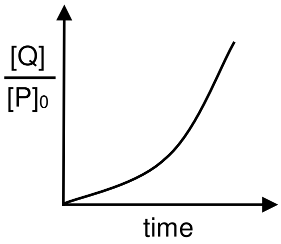
P **Q**

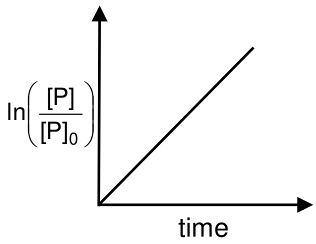
(A)



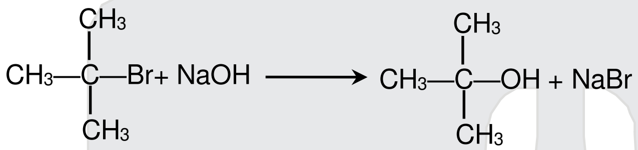
(B)



(C) 

(D) 

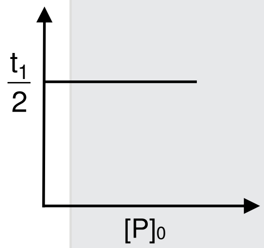
Ans. **(A)**

Sol. 

this is 1st order reaction

For 1st order $T_{1/2} = \dfrac{0.693}{k}$

So independent of initial concentration



$$C = C_0e^{-kt} \Rightarrow \ell n\left[\frac{C}{C_0}\right] = -kt$$

$$\Rightarrow \ell n\left[\frac{[P]}{[P]_0}\right] = -kt$$

So graph D is incorrect.

9. Which among the following statement(s) is(are) true for the extraction of aluminium from bauxite?

(A) Hydrated Al_2O_3 precipitates, when CO_2 is bubbled through a solution of sodium aluminate.

(B) Addition of Na_3AlF_6 lowers the melting point of alumina.

(C) CO_2 is evolved at the anode during electrolysis.

(D) The cathode is a steel vessel with a lining of carbon.

Ans. **(ABCD)**

Sol. (A) $2NaA\ell O_2 + 3H_2O + CO_2 \longrightarrow 2A\ell(OH)_3 + Na_2CO_3$

(B) In Hall-Heroult process $Na_3Al\ell F_6$ and CaF_2 is mixed with $A\ell_2O_3$ to lower melting point & increase conductivity.

(C) Anode $C(s) + 2O^{2-}(melt) \longrightarrow CO_2(g) + 4e^-$

(D) Steel cathode with carbon lining & graphite anode are used.

10. Choose the correct statement(s) among the following.

(A) $SnCl_2 \cdot 2H_2O$ is a reducing agent.

(B) SnO_2 reacts with KOH to form $K_2[Sn(OH)_6]$.

(C) A solution of $PbCl_2$ in HCl contains Pb^{2+} and Cl^- ions.

(D) The reaction of Pb_3O_4 with hot dilute nitric acid to give PbO_2 is a redox reaction.

Ans. **(AB)**

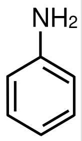
Sol. (A) Sn^{2+} is a good reducing agent which gets oxidise into Sn^{4+}

(B) Amphoteric nature.

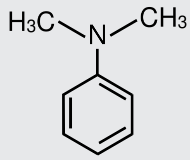
(C) $PbCl_2 + 2Cl^- \longrightarrow [PbCl_4]^{2-}$

(D) $\underset{(2PbO + PbO_2)}{Pb_3O_4} + \underset{(Conc.)}{4HNO_3} \longrightarrow PbO_2\downarrow + 2Pb(NO_3)_2 + 6H_2O$

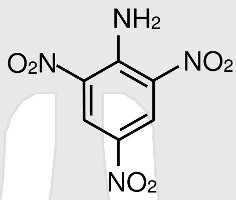
11. Consider the following four compounds **I**, **II**, **III**, and **IV**.



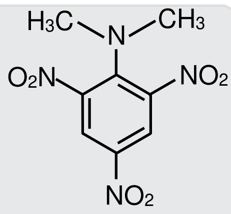
I



II



III



IV

Choose the correct statement(s).

(A) The order of basicity is II > I > III > IV.

(B) The magnitude of pK_b difference between I and II is more than that between III and IV.

(C) Resonance effect is more in III than in IV.

(D) Steric effect makes compound IV more basic than III

Ans. **(CD)**

Sol. The correct basic strength order is

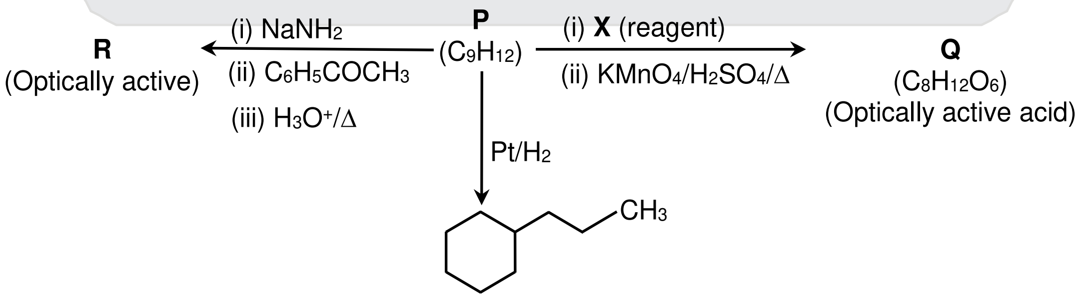
(A) K_b : IV > II > I > III ;

- IV is strongest base due to SIR effect.
- III is weakest base due to –M group of three nitro groups present at Ortho and Para positions.
- II is stronger than I since III is tertiary and I primary aromatic amine.

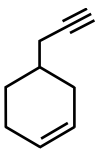
(B) IV is found to be 40,000 times more basic than III. While I & II differ very little in basic strength.

(C,D) Due to SIR effect in IV both $-NO_2$ and $-N(CH_3)_2$ will be out of plane hence resonance effect is more in III than in IV.

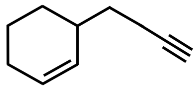
12. Consider the following transformations of a compound **P**.

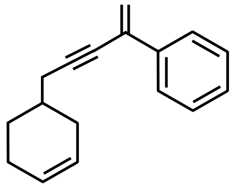


Choose the correct option(s)

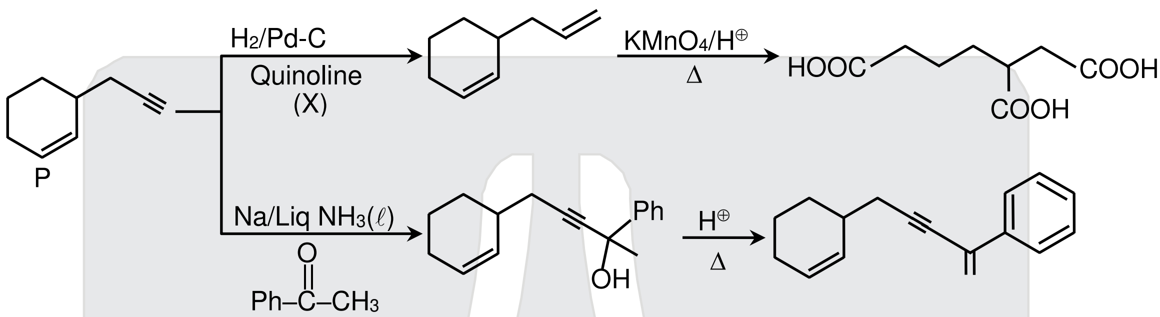
(A) P is 

(B) X is Pd-C/quinoline/H_2

(C) P is 

(D) R is 

Ans. **(BC)**

Sol. 

SECTION 3 (Maximum Marks : 24)

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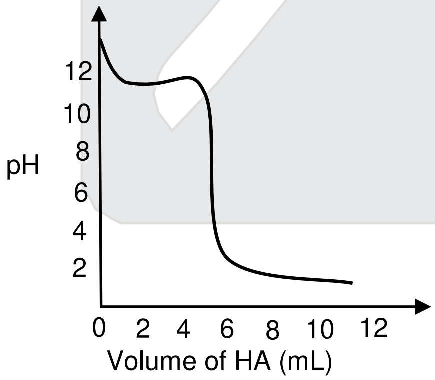
13. A solution of 0.1 M weak base (B) is titrated with 0.1 M of a strong acid (HA). The variation of pH of the solution with the volume of HA added is shown in the figure below. What is the pK_b of the base? The neutralization reaction is given by B + HA → BH^+ + A^-.



Ans. **(03.00)**

Sol. At 3 ml pH of solution is 11

B + HA $\longrightarrow$ BH^+ + A^-

at 3 ml best buffer action is shown

So $\boxed{P_{OH} = P_{K_b} = 3}$ (As basic buffer is formed)

So $\boxed{P_{K_b} = 3}$

14. Liquids **A** and **B** form ideal solution for all compositions of **A** and **B** at 25 °C. Two such solutions with 0.25 and 0.50 mole fractions of **A** have the total vapor pressures of 0.3 and 0.4 bar, respectively. What is the vapor pressure of pure liquid **B** in bar?

Ans. **(0.20)**

Sol. $P_{Total} = P_A^o X_A + P_B^o X_B$

(i) $0.3 = \left(P_A^o\right)\frac{1}{4} + \left(P_B^o\right)\frac{3}{4}$

$P_A^o + P_B^o = 1.2$

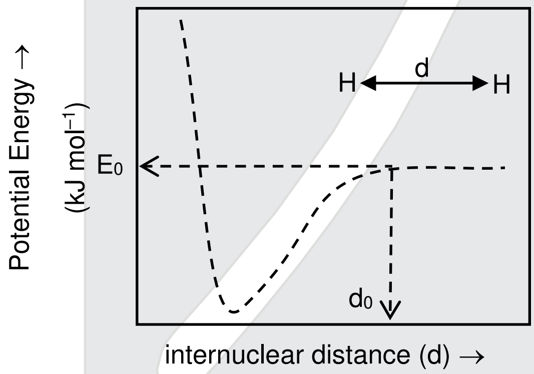
(ii) $0.4 = \left(P_A^o\right)\frac{1}{2} + \left(P_B^o\right)\frac{1}{2}$

$P_A^o + P_B^o = 0.8$

From equation (1) and equation (2)

P_B^o = 0.2 bar and P_A^o = 0.6 bar

15. The figure below is the plot of potential energy versus internuclear distance (d) of H_2 molecule in the electronic ground state. What is the value of the net potential energy E_0 (as indicated in the figure) in kJ mol^{-1}, for $d = d_0$ at which the electron-electron repulsion and the nucleus-nucleus repulsion energies are absent? As reference, the potential energy of H atom is taken as zero when its electron and the nucleus are infinitely far apart.
Use Avogadro constant as 6.023×10^{23} mol^{-1}.



Ans. **(–5246.5)**

Sol. For one H atom

$$P.E. = \frac{kq_1q_2}{r} = -\frac{9\times10^{9}\times\left[1.6\times10^{-19}\right]^2}{0.529\times10^{-10}}$$

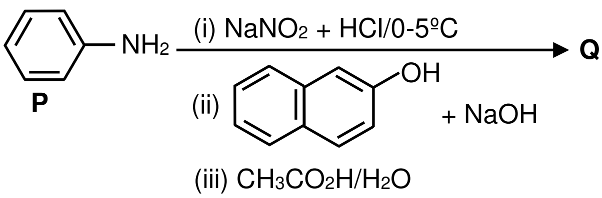
$$= -\frac{9\times1.6\times1.6}{0.529}\times10^{-19}$$

Total potential energy for 2 H-atom (per mole)

$$= -\frac{2\times9\times1.6\times1.6}{0.529}\times10^{-19}\times6\times10^{23} = -5246.5 \text{ KJ/mole}$$

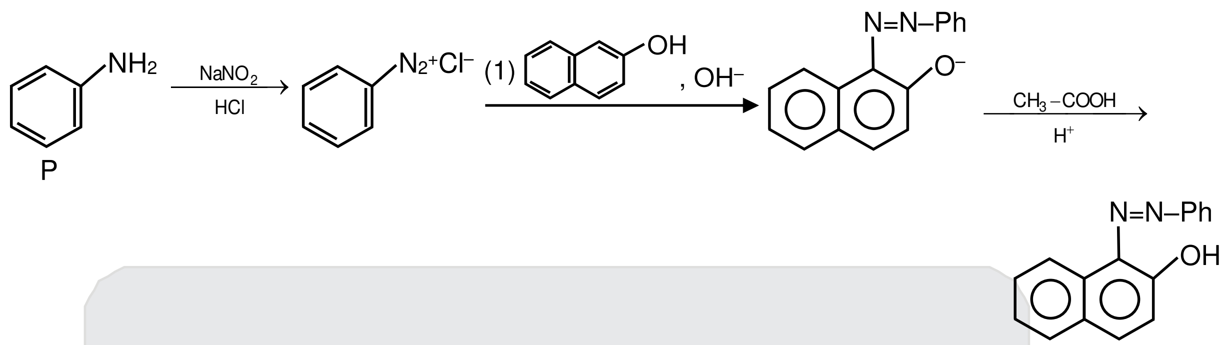
Ans. –5246.5

16. Consider the reaction sequence from **P** to **Q** shown below. The overall yield of the major product **Q** from **P** is 75%. What is the amount in grams of **Q** obtained from 9.3 mL of **P**? (Use density of **P** = 1.00 g mL^{-1}; Molar mass of C = 12.0, H =1.0, O =16.0 and N = 14.0 g mol^{-1})



Ans. **18.60**

Sol.



$\Rightarrow$ Molar mass of 'P' (C_6H_7N) = 93 g

$\Rightarrow$ Mole of 'P' = $\left(\frac{9.3g}{ml} \times 1ml\right) \times \frac{1}{93g}$ = 0.1 mole

$\Rightarrow$ Molar mass of 'Q' = 248 g

$\Rightarrow$ Mole of 'Q' produced = 0.1 mole

Mass of 'Q' produced = (0.1 × 248 × 0.75)g = 18.60 g

17. Tin is obtained from cassiterite by reduction with coke. Use the data given below to determine the minimum temperature (in K) at which the reduction of cassiterite by coke would take place.

At 298 K: $\Delta_f H^0(SnO_2(s)) = -581.0$ kJ mol^{-1}, $\Delta_f H^0(CO_2(g)) = -394.0$ kJ mol^{-1},

$S^0(SnO_2(s)) = 56.0$ J K^{-1}mol^{-1}, $S^0(Sn(s)) = 52.0$ J K^{-1}mol^{-1},

$S^0(C(s)) = 6.0$ J K^{-1}mol^{-1}, $S^0(CO_2(g)) = 210.0$ J K^{-1}mol^{-1}.

Assume that the enthalpies and the entropies are temperature independent.

Ans. **(935)**

Sol. $SnO_2(s) + C(s) \longrightarrow Sn(s) + CO_2(g)$

$\Delta H^0_{rxn} = \Delta H^0_f(CO_2(g)) - \Delta H^0_f(SnO_2, s)$

$= -394.0 - [-581.0]$

= 187 KJ

$\Delta S^0_{rxn} = S^0(sn(s)) + S^0(CO_2(g)) - S^0(SnO_2,(s) - S^0(C(s))$

= 52 +210 – 56 –6

= 200 J

$\boxed{\Delta G^o = \Delta H^o - T\Delta S^o}$

For reaction to be spontaneous

$\Delta G^o < 0$

$\Delta H^o - T\Delta S^o < 0$

$187 \times 1000 - T \times 200 < 0$

$\boxed{T > 935K}$

18. An acidified solution of 0.05 M Zn^{2+} is saturated with 0.1 M H_2S. What is the minimum molar concentration (M) of H^+ required to prevent the precipitation of ZnS? Use K_{sp} (ZnS) = 1.25×10^{-22} and overall dissociation constant of H_2S, $K_{NET} = K_1K_2 = 1 \times 10^{-21}$.

Ans. **(0.2)**

Sol. For ZnS $K_{sp}(ZnS) = [Zn^{2+}] \times [S^{2-}] = 1.25 \times 10^{-22}$

$= 0.05 \times [S^{2-}] = 1.25 \times 10^{-22}$

$[S^{2-}] = 25 \times 10^{-22}$

For H_2S $\quad H_2S \rightleftharpoons 2H^+ + S^{2-}$

0.1M $\qquad 25\times10^{-22}$

$$K_a = \frac{[H^+]^2[S^{2-}]}{[H_2S]} = 1\times10^{-21}$$

$$= \frac{[H^+]^2 \times 25\times10^{-22}}{0.1} = 1\times10^{-21}$$

$$[H^+]^2 = \frac{1}{25}$$

$$[H^+] = \frac{1}{5}$$

$[H^+] = 0.2$ M

Resonance®
Educating for better tomorrow

JEE (MAIN) 2020 RESULT

Few things remain unchanged forever...
So, is our tradition of delivering

Self-Earned & Owned Result

58.68%
Success % of Eligibility to appearance

14717
Classroom: 11047 | Distance: 3670

STUDENTS ELIGIBLE FOR JEE (ADVANCED) 2020

ALL INDIA RANKS (AIRs) IN TOP-200 FROM CLASSROOM

AIR-37
AVI KUMAR
With us since Class 11th

AIR-74
SANKALP PARASHAR
With us since Class 11th

AIR-87
ACHINTYA NATH
With us since Class 11th

AIR-124
UTKARSH P. SINGH
With us since Class 10th

AIR-129
AARYAN K. GUPTA
With us since Class 9th

STATE TOPPER WEST BENGAL

AIR-131
SREEMANTI DEY
With us since Class 11th

AIR-143
RAHUL KANOONGO
With us since Class 13th
हिन्दी माध्यम विद्यार्थी

AIR-148
DHANANJAY KEJRIWAL
With us since Class 9th

AIR-150
PRAKHAR BANSAL
With us since Class 11th

AIR-155
HARSH TRIVEDI
With us since Class 8th

AIR-161
DARSHAN RAKHEWAR
With us since Class 11th

AIR-167
JATIN K. GUPTA
With us since Class 11th

AIR-190
MIR MOHAMMAD ASIF
With us since Class 11th

AIR-198
KUSHAGRA GUPTA
With us since Class 11th

RESULT HIGHLIGHTS

7 AIRs
(AIR-53, 81, 91, 106, 113, 132, 142)
in TOP-200
Distance (DLP)

41 Students
(Classroom: 25 | Distance: 16)
with 100 %tile
in P/C/M

50 AIRs in TOP-500
(Classroom: 36 | Distance: 14)
109 AIRs in TOP-1000
(Classroom: 77 | Distance: 32)

4 AIRs
(SC: AIR-4, 8 & 10 | ST: AIR-9)
in TOP-10
Classroom