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JEE (Main)

PAPER-1 (B.E./B. TECH.)

2022

COMPUTER BASED TEST (CBT)
Questions & Solutions

Date: 28 July, 2022 (SHIFT-2) | TIME : (3.00 a.m. to 6.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: CHEMISTRY

Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | **FAX No. :** +91-022-39167222

To Know more : sms **RESO** at **56677** | **Website :** www.resonance.ac.in | **E-mail :** contact@resonance.ac.in | **CIN :** U80302RJ2007PLC024029

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PART : CHEMISTRY

1. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : Zero orbital overlap is an out of phase overlap.

Reason R : It results due to different orientation / direction of approach of orbitals.

In the light of the above statements, choose the ***correct*** answer from the options

A Both A and R are true and R is the correct explanation of A

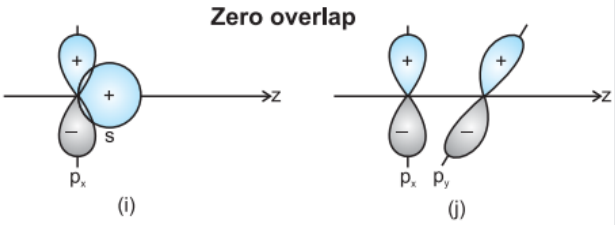
B Both A and R are true but R is NOT the correct explanation of A

C A is true but R is false

D A is false but R is true

Ans. **(A)**

Sol.



Zero overlap (out of phase due to different orientation direction of approach)

2. The correct decreasing order for metallic character is

A Na > Mg > Be > Si > P

B P > Si > Be > Mg > Na

C Si > P > Be > Na > Mg

D Be > Na > Mg > Si > P

Ans. **(A)**

Sol. On moving top to bottom metallic character increases and on moving left to right metallic character decreases.

3. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : The reduction of a metal oxide is easier if the metal formed is in liquid state than solid state.

Reason R : The value of $\Delta G^{\ominus}$ becomes more on negative side as entropy is higher in liquid state than solid state.

In the light of the above statements, choose the most appropriate answer from the options given below

A Both A and R are correct and R is the correct explanation of A

B Both A and R are correct but R is NOT the correct explanation of A

C A is correct but R is not correct

D A is not correct but R is correct

Ans. (A)

Sol. $\Delta G = \Delta H - T\Delta S$

So on melting entropy is increases and ΔG become more negative so metal ion get easily reduced.

4. The products obtained during treatment of hard water using Clark's method are :

A $CaCO_3$ and $MgCO_3$

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

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

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

Ans. (C)

Sol. Clark's method :

$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$

$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$

5. **Statement I** : An alloy of lithium and magnesium is used to make aircraft plates.

Statement II : The magnesium ions are important for cell-membrane integrity.

In the light the above statements, choose the ***correct*** answer from the options given below

A Both Statement I and Statement II are true

B Both Statement I and Statement II are false

C Statement I is true but Statement II is false

D Statement I is false but Statement II is true

Ans. **(B)**

Sol. Statement-I : An alloy of Al & Mg is used in aircraft construction.

Statement-II : Calcium plays important roles in neuromuscular function, interneuronal transmission, cell membrane integrity and blood coagulation.

6. White phosphorus reacts with thionyl chloride to give

A PCl_5, SO_2 and S_2Cl_2

B PCl_3, SO_2 and S_2Cl_2

C PCl_3, SO_2 and Cl_2

D PCl_5, SO_2 and Cl_2

Ans. **(B)**

Sol. $P_4(white) + 8SOCl_2 \longrightarrow 4PCl_3 + 4SO_2 + 2S_2Cl_2$

7. Concentrated HNO_3 reacts with Iodine to give

A HI, NO_2 and H_2O

B HIO_2, N_2O and H_2O

C HIO_3, NO_2 and H_2O

D HIO_4, N_2O and H_2O

Ans. **(C)**

Sol. $I_2 + 10HNO_3 \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$

8. Which of the following pair is not isoelectronic species?

(At. no. Sm, 62; Er, 68; Yb, 70; Lu, 71; Eu, 63; Tb, 65; Tm, 69)

A Sm^{2+} and Er^{3+}

B Yb^{2+} and Lu^{3+}

C Eu^{2+} and Tb^{4+}

D Tb^{2+} and Tm^{4+}

Ans. **NTA answer (D), Resonance answer (A, D)**

Sol. $_{62}Sm^{2+}$: $[_{54}Xe]4f^6$ $_{68}Er^{3+}$: $[_{54}Xe]4f^{11}$

$_{70}Yb^{2+}$: $[_{54}Xe]4f^{14}$ $_{71}Lu^{3+}$: $[_{54}Xe]4f^{14}$

$_{63}Eu^{2+}$: $[_{54}Xe]4f^7$ $_{65}Tb^{4+}$: $[_{54}Xe]4f^7$

$_{65}Tb^{2+}$: $[_{54}Xe]4f^9$ $_{69}Tm^{4+}$: $[_{54}Xe]4f^{11}$

9. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : Permanganate titrations are not performed in presence of hydrochloric acid.

Reason R : Chlorine is formed as a consequence of oxidation of hydrochloric acid.

In the light of the above statements, choose the ***correct*** answer from the options given below

A Both A and R are true and R is the correct explanation of A

B Both A and R are true but R is NOT the correct explanation of A

C A is true but R is false

D A is false but R is true

Ans. **(A)**

Sol. $MnO_4^- + Cl^- \longrightarrow Mn^{2+} Cl_2(g)$

$KMnO_4$ oxidise HCl to Cl_2 that's why for acidic medium HCl is not used in permanganate titration.

10. Match **List I** with **List II**

List I (Complex)	List II (Hybridization)
A. $Ni(CO)_4$	I. sp^3
B. $[Ni(CN)_4]^{2-}$	II. sp^3d^2
C. $[Co(CN)_6]^{3-}$	III. d^2sp^3
D. $[CoF_6]^{3-}$	IV. dsp^2

Choose the correct answer from the options given below :

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

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

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

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

Ans. **(B)**

Sol.

	List-I		List-II
	Complex		Hybridisation
(i)	$[Ni(CO)_4]$	(a)	sp^3
(ii)	$[Ni(CN)_4]^{2-}$	(b)	dsp^2
(iii)	$[CoF_6]^{3-}$	(c)	sp^3d^2
(iv)	$[Co(CN)_6]^{3-}$	(d)	d^2sp^3

11. Dinitrogen and dioxygen, the main constituents of air do not react with each other in atmosphere to form oxides of nitrogen because

A N_2 is unreactive in the condition of atmosphere.

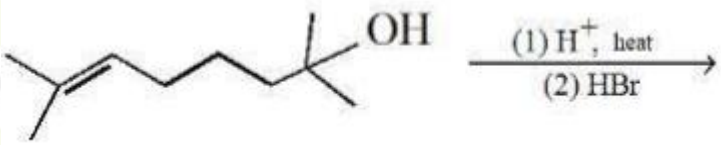
B Oxides of nitrogen are unstable.

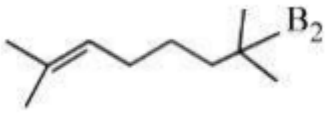
C Reaction between them can occur in the presence of a catalyst.

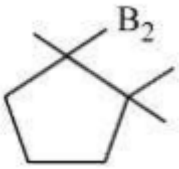
D The reaction is endothermic and require very high temperature.

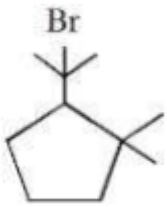
Ans. **(D)**

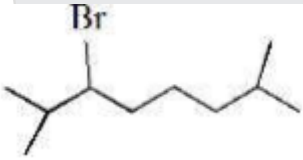
12. The major product in the given reaction is



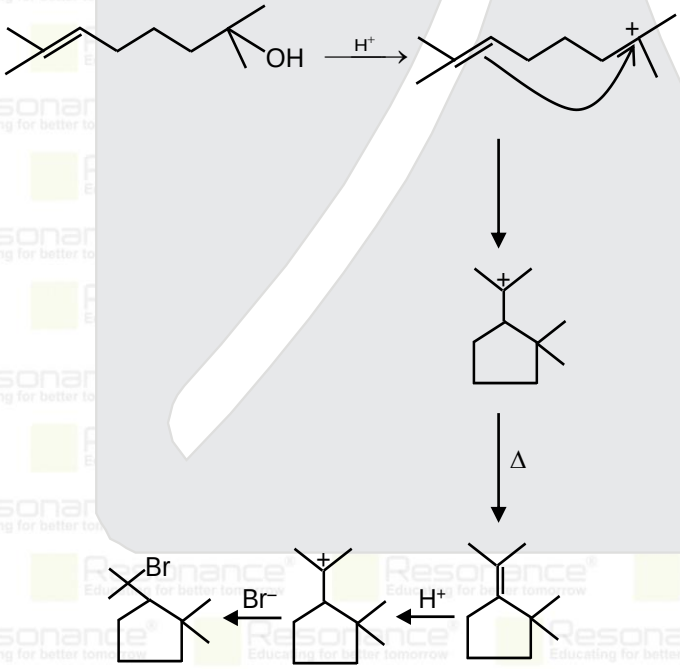
(A) 

(B) 

(C) 

(D) 

Ans. (C)

Sol. 

13. Arrange the following in increasing order of reactivity towards nitration

A. p-xylene

B. bromobenzene

C. mesitylene

D. nitrobenzene

E. benzene

Choose the correct answer from the options given below

A C < D < E < A < B

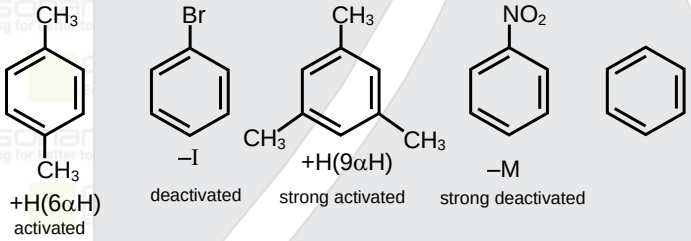
B D < B < E < A < C

C D < C < E < A < B

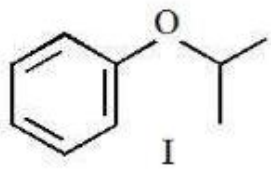
D C < D < E < B < A

Ans. **(B)**

Sol.



14. Compound I is heated with Conc. HI to give a hydroxy compound A which is further heated with Zn dust to give compound B. Identify A and B.

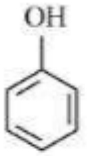
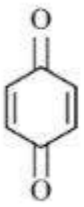


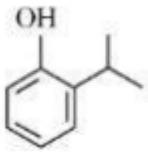
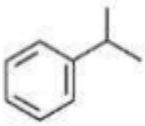
I

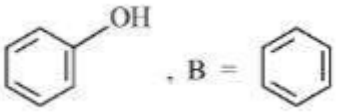
$$\xrightarrow[\Delta]{\text{Conc. HI}} A \xrightarrow{Zn,\ \Delta} B$$

(A) A = 

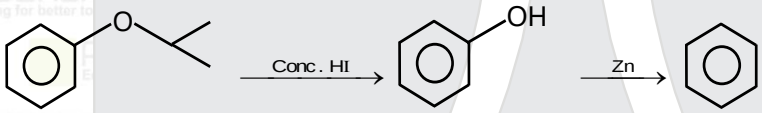
, B = 

(B) A =  , B = 

(C) A =  , B = 

(D) A =  , B =

Ans. **(D)**

Sol. 

15. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : Aniline on nitration yields ortho, meta & para nitro derivatives of aniline.

Reason R : Nitrating mixture is a strong acidic mixture.

In the light of the above statements, choose the ***correct*** answer from the options given below

A Both A and R are true and R is the correct explanation of A

B Both A and R are true but R is NOT the correct explanation of A

C A is true but R is false

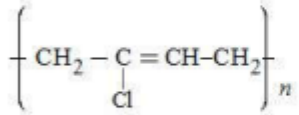
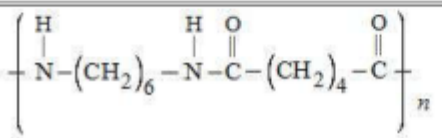
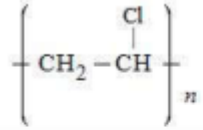
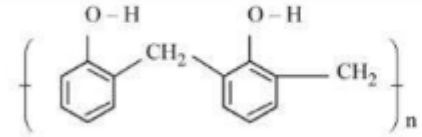
D A is false but R is true

Ans. **(A)**

Sol. Nitration of aniline is carried out in highly acidic medium. In strong acidic medium NO_2^+ electrophile is formed, further a fraction of aniline gets converted to anilinium ion hence nitration product is observed at para, meta and ortho position.

16.

Match **List I** with **List II**

List I (Polymer)	List II (Nature)
A. 	I. Thermosetting polymer
B. 	II. Fibers
C. 	III. Elastomer
D. 	IV. Thermoplastic polymer

Choose the correct answer from the options given below :

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

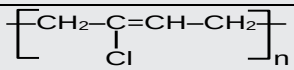
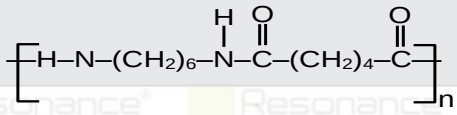
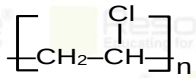
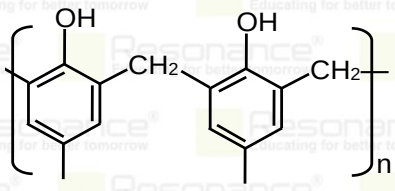
B A-III, B-II, C-IV, D-I

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

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

Ans. (B)

Sol.

(A) Elastomers	(P) 
(B) Fibres	(Q) 
(C) Thermoplastic polymers	(R) 
(D) Thermosetting polymers	(S) 

17. Two statements in respect of drug-enzyme interaction are given below

Statement I : Action of an enzyme can be blocked only when an inhibitor blocks the active site of the enzyme.

Statement II : An inhibitor can form a strong covalent bond with the enzyme.

In the light of the above statements, choose the ***correct*** answer from the options given below

A Both Statement I and Statement II are true

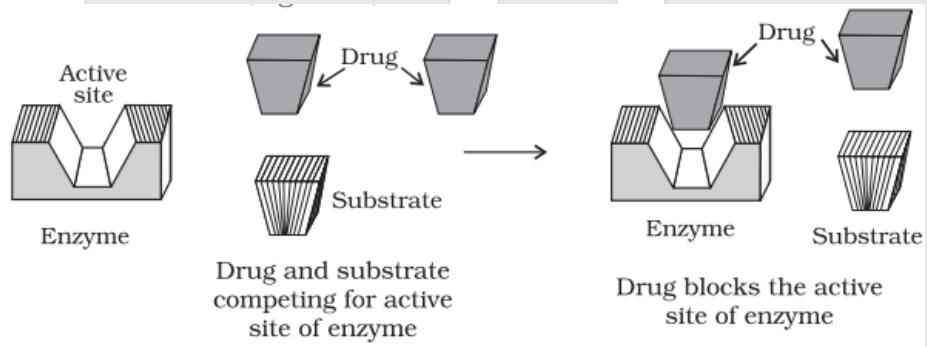
B Both Statement I and Statement II are false

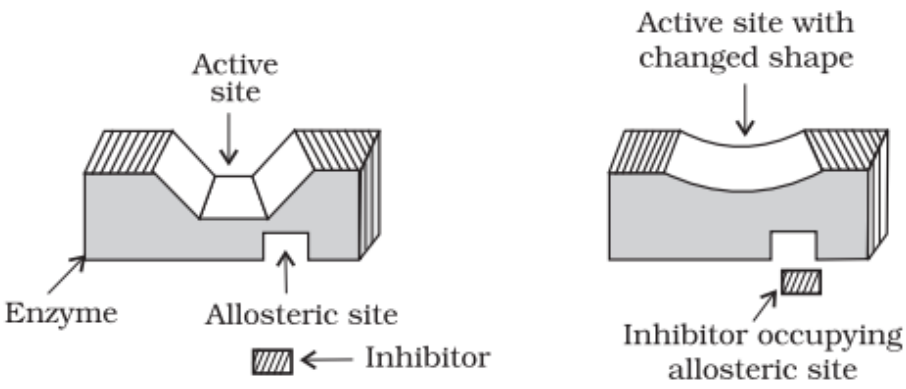
C Statement I is true but Statement II is false

D Statement I is false but Statement II is true

Ans. **(D)**

Sol.





18. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**

Assertion A : Thin layer chromatography is an adsorption chromatography.

Reason R : A thin layer of silica gel is spread over a glass plate of suitable size in thin layer chromatography which acts as an adsorbent.

In the light of the above statements, choose the ***correct*** answer from the options given below

A Both A and R are true and R is the correct explanation of A

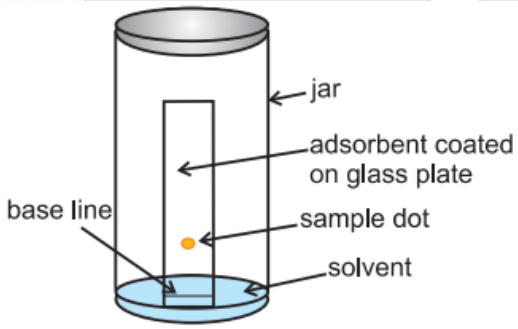
B Both A and R are true but R is NOT the correct explanation of A

C A is true but R is false

D A is false but R is true

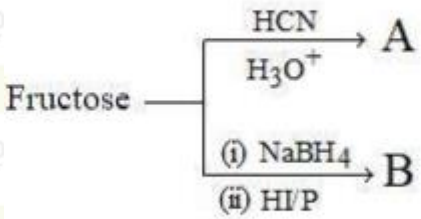
Ans. (A)

Sol.



$$R_f = \frac{\textit{Distance moved by the substance from base line (x)}}{\textit{Distance moved by the solvent from base line (y)}}$$

19. The formulas of A and B for the following reaction sequence



are

A $A = C_7H_{14}O_8,\ B = C_6H_{14}$

B $A = C_7H_{13}O_7,\ B = C_7H_{14}O$

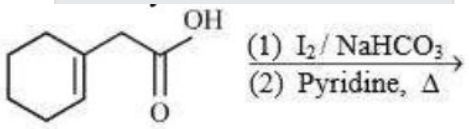
C $A = C_7H_{12}O_8,\ B = C_6H_{14}$

D $A = C_7H_{14}O_8,\ B = C_6H_{14}O_6$

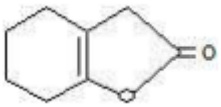
Ans. (A)

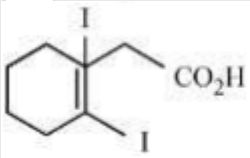
Sol. Fructose → $HCN/H_3O^+ \rightarrow C_7H_{14}O_8$; $NaBH_4$, Red P/HI$\rightarrow C_6H_{14}$

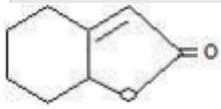
20.

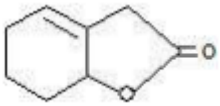


Find out the major product for the above reaction.

(A) 

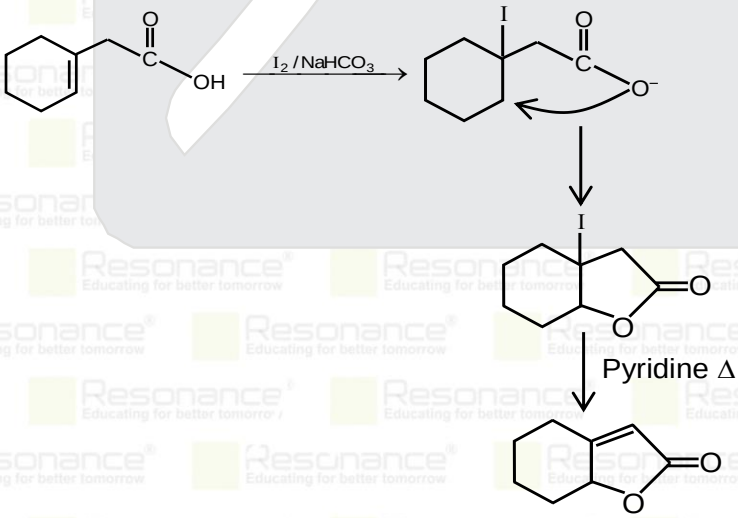
(B) 

(C) 

(D) 

Ans. (C)

Sol.



21. 2L of 0.2M H_2SO_4 is reacted with 2L of 0.1M NaOH solution, the molarity of the resulting product Na_2SO_4 in the solution is _____ millimolar. (Nearest integer)

Ans. (25)

Sol.

	H_2SO_4	+ 2NaCl	⟶	Na_2SO_4
Mole	0.4	0.2		LR is NaCl
	0.3	0		0.1

Molarity of Na_2SO_4 = $\frac{0.1}{4}$ = 0.025 = 25 × 10^{-3} M

22. Metal M crystallizes into a fcc lattice with the edge length of 4.0×10^{-8} cm. The atomic mass of the metal is _____ g/mol. (Nearest integer)

(Use : $N_A = 6.02 \times 10^{23}$ mol^{-1}, density of metal, M = 9.03g cm^{-3})

Ans. **(87)**

Sol. $d = \frac{Z \times M}{N_A \times Volume}$

$9.03 = \frac{4 \times M}{6.02 \times 10^{23} \times (4 \times 10^{-8})^3}$

$M = \frac{9.03 \times 6.02 \times 10^{23} \times 64 \times 10^{-24}}{4}$ = 86.97 gram ≈ 87 g

23. If the wavelength for an electron emitted from H-atom is 3.3×10^{-10} m, then energy absorbed by the electron in its ground state compared to minimum energy required for its escape from the atom, is _____ times. (Nearest integer)

[Given : h = 6.626×10^{-34} J s]

Mass of electron = 9.1×10^{-31} kg

Ans. (2)

Sol. For electron

$\lambda = \frac{12.3}{\sqrt{V}}$

$3.3 = \frac{12.3}{\sqrt{V}}$

$V = \left(\frac{12.3}{3.3}\right)^2$ = 13.91 eV

(KE) = 13.9 eV

$E = E_0 + KE$

E = (13.6 + 13.91)

$\left(\frac{E}{E_0}\right) = \frac{(13.6 + 13.91)}{13.6} \approx 2$

24. A gaseous mixture of two substances A and B, under a total pressure of 0.8 atm is in equilibrium with an ideal liquid solution. The mole fraction of substance A is 0.5 in the vapour phase and 0.2 in the liquid phase. The vapour pressure of pure liquid A is _____ atm. (Nearest integer)

Ans. **(2)**

Sol. $P_A = P_A^o \times X_A = (P_{Total})Y_A$

$(P_A^o)\ 0.2 = 0.8 \times 0.5$

$P_A^o = 2$ atm

25. At 600K, 2 mol of NO are mixed with 1 mol of O_2.

$$2NO_{(g)} + O_2\,(g) \rightleftharpoons 2NO_2(g)$$

The reaction occurring as above comes to equilibrium under a total pressure of 1 atm. Analysis of the system shows that 0.6 mol of oxygen are present at equilibrium. The equilibrium constant for the reaction is _____. (Nearest integer)

Ans. **(2)**

Sol.

	$2NO(g)$	$+\ O_2(g)$	$\longrightarrow 2NO_2\,(g)$
t = 0	2 mole	1 mole	0
	1.2 mole	0.6 mole	0.8

$n_{Total} = 2.6$

$$K_P = \frac{(P_{NO_2})^2}{(P_{NO})^2(P_{O_2})} = \frac{\left(\frac{0.8}{2.6}\times 1\right)^2}{\left(\frac{1.2}{2.6}\right)^2\left(\frac{0.6}{2.6}\right)} = \frac{(0.8)^2\times 2.6}{(1.2)^2\times 0.6} = \frac{1.664}{0.864} = 1.8824 \approx 2 \text{ atm}$$

26. A sample of 0.125g of an organic compound when analyzed by Duma's method yields 22.78 mL of nitrogen gas collected over KOH solution at 280 K and 759 mm Hg. The percentage of nitrogen in the given organic compound is _____. (Nearest integer)

Given :

(a) The vapour pressure of water of 280 K is 14.2 mm Hg.

(b) $R = 0.082$ L atm K^{-1} mol^{-1}

Ans. **(22)**

Sol. Volume of N_2 gas = 22.78 mol

Pressure of dry N_2 gas = 759 – 14.2 = 744.8 mm

Temperature = 280 K

Mole of N_2 gas = $\frac{PV}{RT} = \frac{744.8 \times 22.78}{760 \times 1000 \times 0.0821 \times 280}$

Weight of N_2 gas = $\frac{744.8 \times 22.78 \times 28}{760 \times 1000 \times 0.0821 \times 280} = 0.02719$

% of N_2 = $\frac{0.02719}{0.125} \times 100 = 21.75 \approx 22$

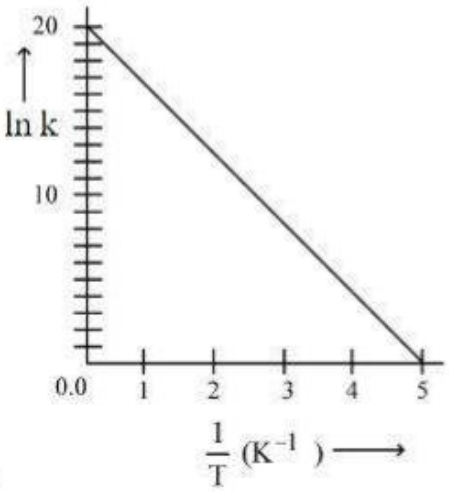
27. On reaction with stronger oxidizing agent like KIO_4, hydrogen peroxide oxidizes with the evolution of O_2. The oxidation number of I in KIO_4 changes to _____.

Ans. (5)

Sol. $\overset{-1}{H_2O_2} + \overset{+7}{KIO_4} \longrightarrow \overset{+5}{KIO_3} + O_2 + H_2O$

28. For a reaction, given below is the graph of ln k vs $\frac{1}{T}$. The activation energy for the reaction is equal to _____ cal mol^{-1}. (nearest integer)

(Given : R = 2 cal K^{-1} mol^{-1})



Ans. **(8)**

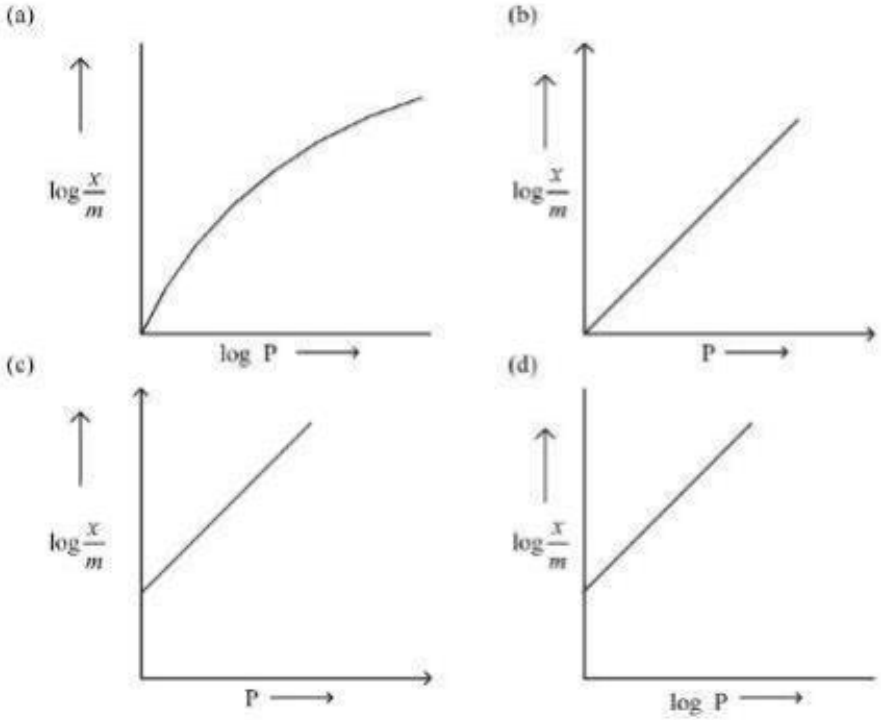
Sol. $K = Ae^{-Ea/RT}$

$\ln k = \ln A - \left(\frac{Ea}{R}\right)\frac{1}{T}$

Slope of graph = $-\left(\frac{E_a}{R}\right) = \left(\frac{0-20}{5-0}\right)$

$E_a = 4 \times 2 = 8$ cal.

29. Among the following the number of curves not in accordance with Freundlich adsorption isotherm is _____.



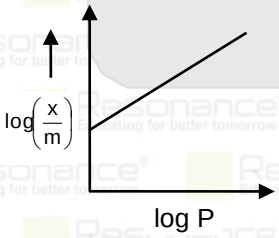
Ans. **(3)**

Sol. Fraundlich adsorption isotherm.

$$\frac{x}{m} = k(P)^{\frac{1}{n}}$$

$$\log\left(\frac{x}{m}\right) = \log k + \frac{1}{n}\log(P)$$

graph between $\log\left(\frac{x}{m}\right)$ Vs log (P)



30. Among the following the number of state variables is _____.

Internal energy (U)

Volume (V)

Heat (q)

Enthalpy (H)

Ans. **(3)**

Sol. Sate variable ⇒ Volume, Enthalpy, Internal energy,
Path function ⇒ Heat

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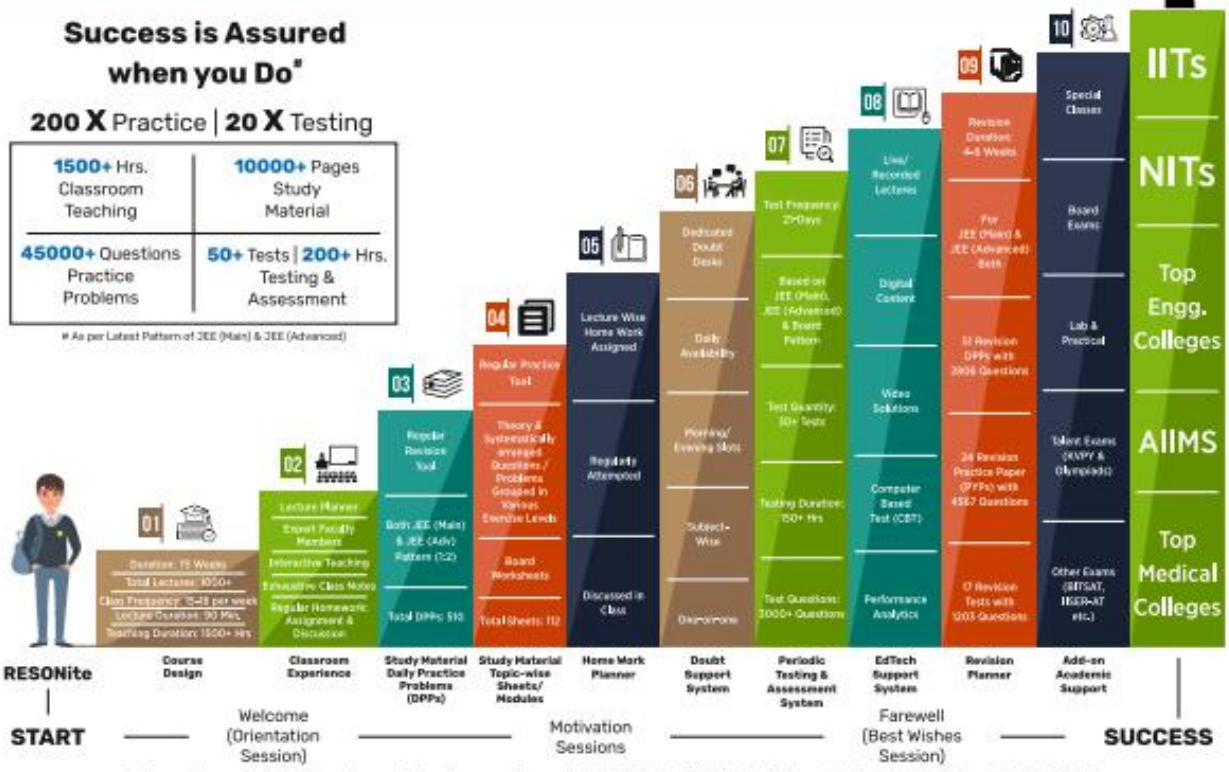

The figures (approx.) shown in the graph are of 2 Years Classroom Program (VIKAAS-XI & VIJETA-XII) for JEE (Advanced) @ Resonance in Academic Session 2021-22.
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