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JEE (Main)

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

2023

COMPUTER BASED TEST (CBT)

Questions & Solutions

Date: 01 February, 2023 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 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

31. Which of the following complex will show largest splitting of d-orbitals ?

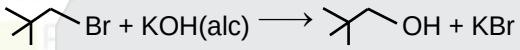
(1) $[Fe(C_2O_4)_3]^{3-}$ (2) $[Fe(CN)_6]^{3-}$ (3) $[Fe(NH_3)_6]^{3+}$ (4) $[F_6F_6]^{3-}$

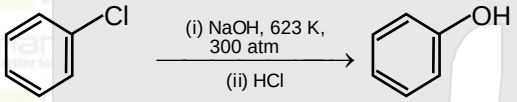
NTA (2)

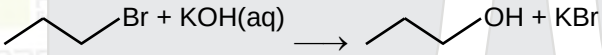
RESO (2)

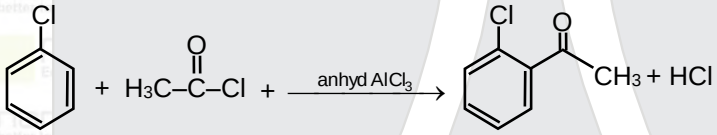
Sol. CN^- is strong ligand, So $[Fe(CN)_6]^{3-}$ has maximum CFSE

32. Identify the incorrect option from the following :

(1) 

(2) 

(3) 

(4) 

NTA. (1)

RESO (1)

Sol.  Br will not undergo elimination with KOH(alc) as it has no α "H", nor it will undergo substitution to give  OH , as it has extensive α-branching.

33. Match List I with List II :

List-I (Test)		List-II (Functional group/Class of Compound)	
(A)	Molisch's Test	(I)	Peptide
(B)	Biuret Test	(II)	Carbohydrate
(C)	Carbylamine Test	(III)	Primary amine
(D)	Schiff's Test	(IV)	Aldehyde

Choose the correct answer from the options given below :

(1) A – III ; B – IV ; C – II ; D – I (2) A – II ; B – I ; C – III ; D – IV

(3) A – III ; B – IV ; C – I ; D – II (4) A – I ; B – II ; C – III ; D – IV

NTA. (2)

RESO (2)

Sol. Based on facts.

34. A solution of $FeCl_3$ when treated with $K_4[Fe(CN)_6]$ gives a prussiun blue precipitate due to the formation of :

(1) $Fe[Fe(CN)_6]$ (2) $K[Fe_2(CN)_6]$ (3) $Fe_4[Fe(CN)_6]_3$ (4) $Fe_3[Fe(CN)_6]_2$

NTA. (3)

RESO (3)

Sol. $4Fe^{3+} + 3\,[Fe(CN)_6]^{4-} \longrightarrow Fe_4[Fe(CN)_6]_3 \downarrow$ Prussian blue precipitate.

35. Which of the following are the example of double salt?

A. $FeSO_4.(NH_4)_2SO_4.6H_2O$

B. $CuSO_4.4NH_3.H_2O$

C. $K_2SO_4.Al_2(SO_4)_3.24H_2O$

D. $Fe(CN)_2.4KCN$

Choose the correct answer

(1) A and B only (2) A, B and D only

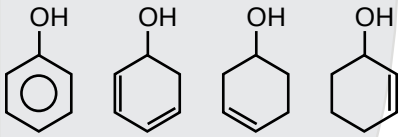
(3) A and C only (4) B and D only

NTA. (3)

RESO (3)

Sol. $FeSO_4.(NH_4)_2SO_4.6H_2O$, $K_2SO_4.Al_2(SO_4)_3.24H_2O$ are example double salt.

36. Decreasing order of dehydration of the following alcohols is



(A) (B) (C) (D)

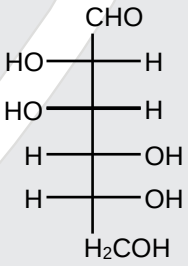
(1) a > d > b > c (2) d > b > c > a (3) b > a > d > c (4) b > d > c > a

NTA. (4)

RESO (4)

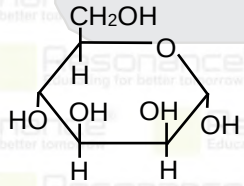
Sol. Easy of dehydration $\propto$ stability of carbocation.

37. The correct representation in six membered pyranose form for the following sugar [XI is

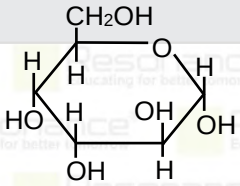


Sugar[X]

(1)



(2)



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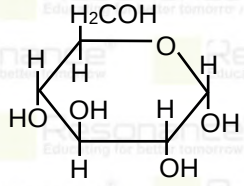
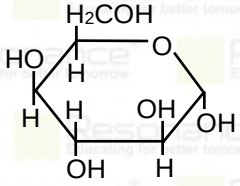
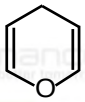


(4)

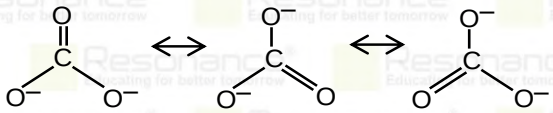


NTA. (1)

RESO (1)

Sol. Pyranose from has a 6 member cycle, similar to pyran 

38. Resonance in carbonate ion (CO_3^{2-}) is



Which of the following is true?

(1) All these structures are in dynamic equilibrium with each other.

(2) Each structure exists for equal amount of time.

(3) CO_3^{2-} has a single structure i.e, resonance hybrid of the above three structures.

(4) It is possible to identify each structure individually by some physical or chemical method.

NTA (3)

RESO (3)

Sol. CO_3^{2-} exist as resonance hybrid

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

Assertion A: Hydrogen is an environment friendly fuel.

Reason R: Atomic number of hydrogen is 1 and it is a very light element.

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

(1) Both A and R are true and R is the correct explanation of A

(2) A is true but R is false

(3) A is false but R is true

(4) Both A and R are true but R is NOT the correct explanation of A

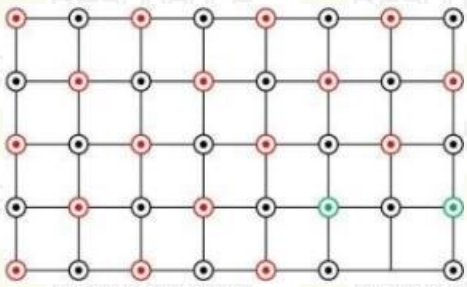
NTA (4)

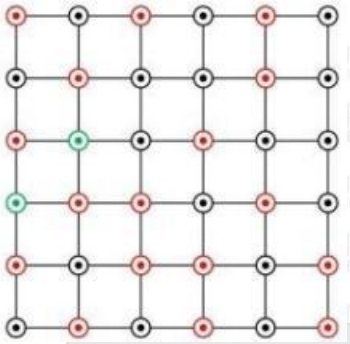
RESO (4)

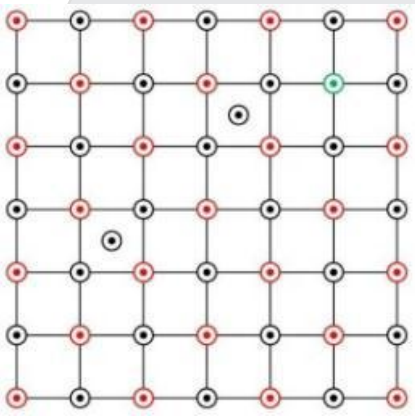
Sol. Dihydrogen is used in fuel cells for generating electrical energy. It has many advantages over the conventional fossil fuels and electric power. It does not produce any pollution and releases greater energy per unit mass of fuel in comparison to gasoline and other fuels.

40. Which of the following represents the lattice structure of $A_{0.95}O$ containing A^{2+}, A^{3+} and O^{2-} ions?

A^{2+} A^{3+} O^{2-}

A. 

B. 

C. 

(1) A and B only (2) B and C only (3) A only (4) B only

NTA (3)

RESO (3)

Sol. One A^{+2} is missing then two A^{2+} ions are converted into A^{3+} ion so 0.05 A^{2+} ion are missing and (0.05×2) A^{2+} ion are converted in A^{3+} ion so for each O^{2-} ion total A^{2+} ion 0.85 and A^{3+} ion is 0.1.
For 20 O^{2-} ion total 17 A^{2+} ion and 2 A^{3+} ions.

41. How can photochemical smog be controlled?
(1) By using catalytic convertors in the automobiles/industry.
(2) By complete combustion of fuel.
(3) By using catalyst.
(4) By using tall chimneys.

NTA (1)

RESO (1)

Sol. Fact from NCERT-XI (vol.-2) Pg. 405

42. Match List I with List II :

List-I		**List-II**	
(A)	Slaked lime	(I)	NaOH
(B)	Dead burnt plaster	(II)	$Ca(OH)_2$
(C)	Caustic soda	(III)	$Na_2CO_3.10H_2O$
(D)	Washing soda	(IV)	$CaSO_4$

Choose the correct answer from the options given below:
(1) (A) - III, (B) - IV, (C) - II, (D) – I (2) (A) - III, (B) - II, (C) - IV, (D) – I
(3) (A) - I, (B) - IV, (C) - II, (D) – III (4) (A) - II, (B) - IV, (C) - I, (D) - III

NTA (1)
RESO (1)
Sol.

Slaked Lime	$Ca(OH)_2$
Caustic Soda	NaOH
Washing Soda	$Na_2CO_3.10H_2O$
Dead Burnt Plaster	$CaSO_4$

43. Match List I with List II :

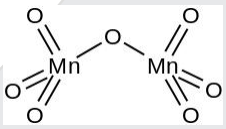
List-I		**List-II**	
(A)	Tranquilizers	(I)	Anti blood clotting
(B)	Aspirin	(II)	Salvarsan
(C)	Antibiotic	(III)	antidepressant drugs
(D)	Antiseptic	(IV)	soframicine

Choose the correct answer from the options given below:
(1) (A) - II, (B) - IV, (C) - I, (D) – II (2) (A) - IV, (B) - II, (C) - I, (D) – II
(3) (A) - III, (B) - I, (C) - II, (D) – IV (4) (A) - II, (B) - I, (C) - III, (D) - IV

NTA (3)
RESO (3)
Sol. Based on fact given in NCERT.

44. Highest oxidation state of Mn is exhibited in Mn_2O_7. The correct statements about Mn_2O_7; are
(A) Mn is tetrahedrally surrounded by oxygen atoms.
(B) Mn is octahedrally surrounded by oxygen atoms.
(C) Contains Mn-O-Mn bridge.
(D) Contains Mn-Mn bond.
Choose the correct answer from the options given below:
(1) A and D only (2) A and C only (3) B and C only (4) B and D only

NTA (2)
RESO (2)
Sol. Mn_2O_7



sp^3 Hybridisation
tetrahedral

45. Given below are two statements:
Statement I: Chlorine can easily combine with oxygen to form oxides; and the product has a tendency to explode
Statement II: Chemical reactivity of an element can be determined by its reaction with oxygen and halogens.
In the light of the above statements, choose the **correct** answer from the options given below
(1) Both the Statements I and II are false
(2) Both the Statements I and II are true
(3) Statement I is false but Statement II is true
(4) Statement I is true but Statement II is false

NTA (2)
RESO (2)
Sol. Chlorine forms explosive oxide. O_2 & F_2 reacts with most of the elements.

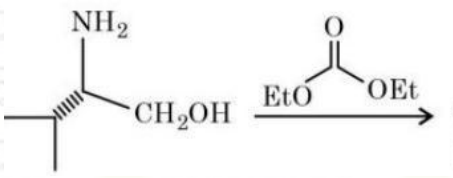
46. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion A: In an Ellingham diagram, the oxidation of carbon to carbon monoxide shows a negative slope with respect to temperature.
Reason R: CO tends to get decomposed at higher temperature.
In the light of the above statements, choose the correct answer from the options given below
(1) A is correct but R is not correct
(2) A is not correct but R is correct
(3) Both A and R are correct and R is the correct explanation of A
(4) Both A and R are correct but R is NOT the correct explanation of A
NTA (1)
RESO (1)
Sol. $\underset{(s)}{C} + \frac{1}{2}\underset{(g)}{O_2} \longrightarrow \underset{(g)}{CO}$

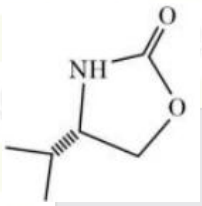
$\Delta n_g = +\frac{1}{2}$

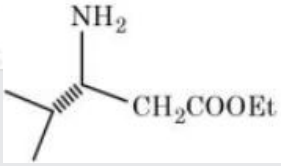
as number of moles of gas increases entropy increases.
Δs = +ve
$\Delta G = \Delta H - T\Delta S$
slope = $-\Delta S$ = –ve
CO is not decomposed at high temperature.

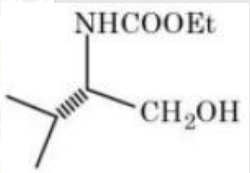
47. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R.**
Assertion A: Amongst He, Ne, Ar and Kr;
1 g of activated charcoal adsorbs more of Kr
Reason R: The critical volume V_c ($cm^3\ mol^{-1}$) and critical pressure P_c (atm) is highest for Krypton but the compressibility factor at critical point Z_c is lowest for Krypton.
In the light of the above statements, choose the correct answer from the options given below
(1) Both A and R are true but R is NOT the correct explanation of A
(2) Both A and R are true and R is the correct explanation of A
(3) A is false but R is true
(4) A is true but R is false
NTA (4)
RESO (4)
Sol. Since Kr has maximum moles mass it has more Vander waal forces so critical temperature is high & gas having more critical temperature is more adsorbed on activated charcoal.
At critical points compressibility facto Z is same for all gases.

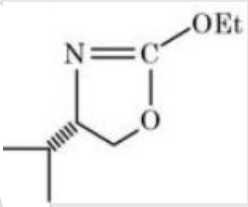
48. In the following reaction, 'A' is :



(1) 

(2) 

(3) 

(4) 

NTA (1)
RESO (1)
Sol. Given reactant under goes S_N2 th reaction with diethyl carbonate.

49. Choose the correct statement(s):
A. Beryllium oxide is purely acidic in nature.
B. Beryllium carbonate is kept in the atmosphere of CO_2.
C. Beryllium sulphate is readily soluble in water.
D. Beryllium shows anomalous behavior.
Choose the correct answer from the options given below:
(1) A, B and C only (2) B, C and D only (3) A and B only (4) A only

NTA (2)
RESO (2)
Sol. BeO is amphoteric. $BeSO_4$, and $MgSO_4$ are readily soluble in water. Beryllium, the first member of the Group 2 metals, shows anomalous behaviour as compared to magnesium and rest of the members. Beryllium carbonate is unstable.

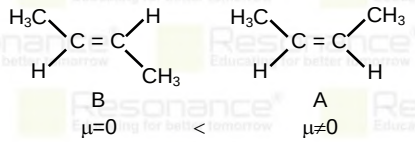
50. But-2-yne is reacted separately with one mole of Hydrogen as shown below:

$$(B) \xleftarrow[liq.NH_3]{Na} CH_3-C\equiv C-CH_3 \xrightarrow[\Delta]{Pd/C} (A)$$
$$+H_2$$

A. A is more soluble than B.
B. The boiling point & melting point of A are higher and lower than B respectively.
C. A is more polar than B because dipole moment of A is zero.
D. Br_2 adds easily to B than A.
Identify the incorrect statements from the options given below:
(1) A, C & D only (2) A and B only (3) B, C & D only (4) B and C only

NTA (3)
RESO (Bonus)

Sol.

Physical properties	 B $\mu=0$ < A $\mu\neq0$	**Remarks**
Dipole moment	A > B	cis-isomer has resultant of dipoles while in trans isomer dipole moments cancel out
Boiling point	A > B	Molecules having higher dipole moment have higher boiling point due to larger intermoleculer force of attraction
Solubility (in H_2O)	A > B	More polar molecules are more soluble in H_2O.
Melting point	B > A	More symmetric isomers have higher melting points due to better packing in crystalline lattice & trans isomers are more symmetric than cis.

The correct answer should be (C) and (D) only.

51. The density of 3 M solution of NaCl is 1.0 g mL^{-1}. Molality of the solution is × _____ 10^{-2} m. (Nearest integer).
Given: Molar mass of Na and Cl is 23 and 35.5 g mol^{-1} respectively .

NTA. (364)

RESO. (364)

Sol. $$\text{Molality(m)} = \frac{M\times1000}{1000\times d - M\times M_{solute}}$$

$$= \left(\frac{3\times1000}{1000\times1-3\times58.5}\right)$$

$$= 3.6386 \text{ m}$$

$$= 363.86 \times 10^{-2} \text{ m} \quad \text{Ans. = 364}$$

52. Sum of oxidation states of bromine in bromic acid and pebromic acid is_____.

NTA. (12)

RESO. (12)

Sol. $HBrO_4 \rightarrow$ Perbromic acid

$(+1) + x + 4(-2) = 0$

$x = +7$

$HBrO_3 \rightarrow$ Bromic acid

$(+1) + x + 3(-2) = 0$

$x = +5$

Sum of oxidation numbers of Bromine = 7 + 5 = 12

53. 25 mL of an aqueous solution of KCl was found to require 20 mL of 1 M $AgNO_3$ solution when titrated using K_2CrO_4j as an indicator. What is the depression in freezing point of KCl solution of the given concentration?

_____ (Nearest integer)

(Given : K_f = 2.0 K kg mol^{-1})

Assume (1) 100% ionization and

(2) density of the aqueous solution as 1 g mL^{-1}

NTA. (3)

RESO. (3)

Sol. 25 ml KCl v/s 20mL of 1M $AgNO_3$

Molarity of KCl = $\frac{20\times1}{25} = \frac{4}{5}M = \frac{0.8\ mol}{L}$

1L solution has 0.8 mol KCl

1L $\Rightarrow$ 1000 g solution

mass of KCl = 0.8 × 74.5

= 59.6 $\simeq$ 60

mass of solvent $\Rightarrow$ 1000 – 60 = 940 g

= 0.940 kg

$\Delta T_f = K_f$ mi

= 3.40 $\simeq$ 3

54. A and B are two substances undergoing radioactive decay in a container. The half life of A is 15 min and that of B is 5 min. If the initial concentration of B is 4 times that of A they both start decaying at the same time, how much time will it take for the concentration of both of them to be same?

_____ min.

NTA. (15)

RESO. (15)

Sol. $t_{1/2})_A$ = 15 min

$t_{1/2})_B$ = 5 min

$[B]_{initial} = 4[A]_{intial}$

$[B]_{final} = [B]_{intial}\left(\frac{1}{2}\right)^{t/15}$

$[A]_{final} = [A]_{intial}\left(\frac{1}{2}\right)^{t/5}$

$[B]_{final} = [A]_{final}$

t = 15

55. (i) $X(g) \rightleftharpoons Y(g) + Z(g)$ $K_{p1} = 3$

(ii) $A(g) \rightleftharpoons 2B(g)$ $K_{p2} = 3$

If the degree of dissociation and initial concentration of both the reactants X(g) and A(g) are equal, then the ration of the total pressure at equilibrium $\left(\frac{P_1}{P_2}\right)$ is equal to x :1. The value of x is _____(Nearest integer)

NTA. (12)

RESO. (12)

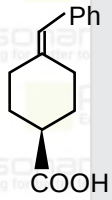
Sol. $X(g) \rightleftharpoons Y(g) + Z(g)$ $\quad K_{P_1} = \frac{\alpha^2}{1-\alpha^2} \times P_1 = 3$

$A(g) \rightleftharpoons 2B(g)$ $\quad K_{P_2} = \frac{4\alpha^2}{1-\alpha^2} \times P_2 = 1$

$$\frac{K_{P_1}}{K_{P_2}} = \frac{P_1}{4P_2} = \frac{3}{1}$$

so $\left(\frac{P_1}{P_2}\right) = 12$

56. The total number of chiral compounds from the following is _____.



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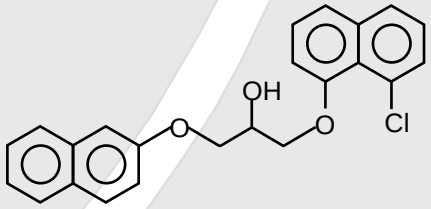

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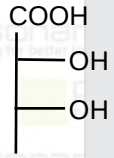

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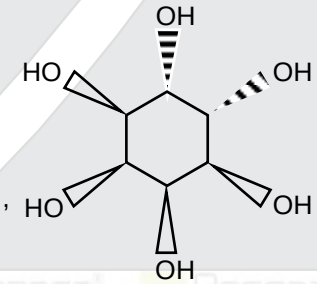

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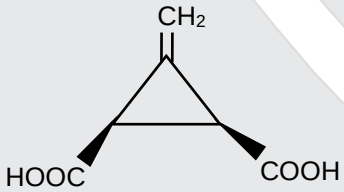
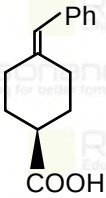


NTA (2)

RESO (2)

Sol.



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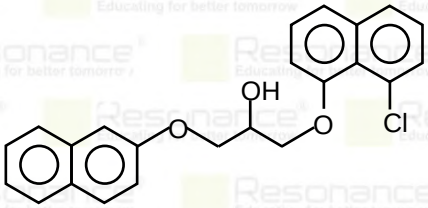


are chiral, as they have neither plane of symmetry nor centre of symmetry.

57. At what pH, given half cell MnO_4^- (0.1M) | Mn^{2+} (0.001 M) will have electrode potential of 1.282 V?_____ (Nearest Integer)

Given $E^o_{MnO_4^-|Mn^{2+}} = 1.54V, \frac{2.303RT}{F} = 0.059V$

NTA. (3)

RESO. (3)

Sol. $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

10^{-1} M $\qquad\qquad$ 10^{-3} M

$$E_{RP} = E^0_{RP} - \frac{0.059}{5}\log\frac{[Mn^{2+}]}{[MnO_4^-][H^+]^8}$$

$$1.282 = 1.54 - \frac{0.059}{5}\log\frac{10^{-3}}{10^{-1}\times[H^+]^8}$$

$$-0.258 = -\frac{0.06}{5}[\log 10^{-2} - 8\log[H^+]]$$

$$-0.258 = -\frac{0.06}{5}[-2 + 8\,pH]$$

$$-21.5 = 2 - 8\,pH$$

$$+\frac{23.5}{8} = pH$$

$$pH = 2.9375 \approx 3$$

58. Electrons in a cathode ray tube have been emitted with a velocity of 1000 m s^{-1}. The number of following statements which is/are <u>true</u> about the emitted radiation is_____.

Given: $h = 6 \times 10^{-34}$ J s, $m_e = 9 \times 10^{-31}$ kg.

(1) The deBroglie wavelength of the electron emitted is 666.67 nm.

(2) The characteristic of electrons emitted depend upon the material of the electrodes of the cathode ray tube.

(3) The cathode rays start from cathode and move towards anode.

(4) The nature of the emitted electrons depends on the nature of the gas present in cathode ray tube.

NTA. (2)

RESO. (2)

Sol. Given mass of e^- = 9×10^{-31} kg $\quad$ $h = 6 \times 10^{-34}$ J/sec

$$\text{wavelength } (\lambda) = \frac{h}{m_e v_e} = \frac{6\times10^{-34}}{9\times10^{-31}\times10^3}$$

$$= \frac{2}{3}\times10^{-6}\,m$$

$= 0.66667 \times 10^{-6}$ m

$= 666.67 \times 10^{-9}$ m

= 666.67 nm

Cathode rays does not depends on nature of gas and metal plate.

59. At 25°C, the enthalpy of the following processes are given:

$H_2(g) + O_2(g) \rightarrow 2OH(g)$ $\quad \Delta H^o = 78$ kJ mol^{-1}

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$ $\quad \Delta H^o = 242$ kJ mol^{-1}

$H_2(g) \rightarrow 2H(g)$ $\quad \Delta H^o = 436$ kJ mol^{-1}

$\frac{1}{2}O_2(g) \rightarrow O(g)$ $\quad \Delta H^o = 249$ kJ mol^{-1}

What would d be the value of X for the following reaction?_____

(Nearest integer)

$H_2O(g) \rightarrow H(g) + OH(g)$ ΔH^o = kJ mol^{-1}

NTA. (499)

RESO. (499)

Sol. $H_2O(g) \rightarrow H(g) + OH(g)$ ΔH^o = kJ mol^{-1}

$2H_2O \rightarrow 2H_2 + O_2$ $\quad \Delta H = +242 \times 2 = 484$

$H_2 + O_2 \rightarrow 2OH$ $\quad \Delta H = 78$

$2H_2O \rightarrow H_2 + 2OH$ $\quad \Delta H = 562$

$H_2 \rightarrow 2H$ $\quad \Delta H = 436$

$2H_2O \rightarrow 2H + 2OH$ $\quad \Delta H = 998$

$H_2O \rightarrow H + OH$ $\quad \Delta H = 499$

60. Number of isomeric compounds with molecular formula $C_9H_{10}O$ which

(i) do not dissolve in NaOH.

(ii) do not dissolve in HCl.

(iii) do not give orange precipitate with 2,4-DNP.

(iv) on hydrogenation give identical compound with molecular formula $C_9H_{12}O$ is _____.

NTA (2)

RESO (12)

Sol. (A) $C_9H_{10}O \xrightarrow{H_2/Pd} C_9H_{12}O$ (B)

DU = 5 $\quad$ DU = 4

Observation: aromatic (phenyl group)

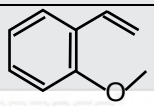
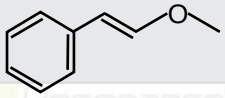
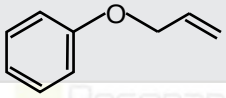
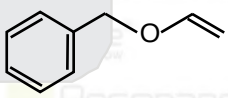
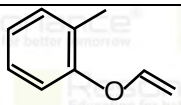
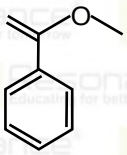
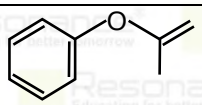
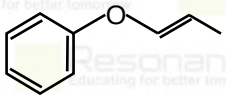
No reaction with NaOH/KOH $\Rightarrow$ no acidic group

Not soluble in HCl $\Rightarrow$ not aniline or ester

No reaction with NaOH/KOH $\Rightarrow$ no aldehyde group

No reaction with 2,4-DNP $\Rightarrow$ no carbonyl group

Therefore only unsaturated phenyl ether is expected in $C_9H_{10}O$.

$C_9H_{12}O \longrightarrow$  3 → o,m,p			
 3 → o,m,p			
			

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