JEE Main September 2020

Question Paper With Text Solution

2 September| Shift-2

CHEMISTRY

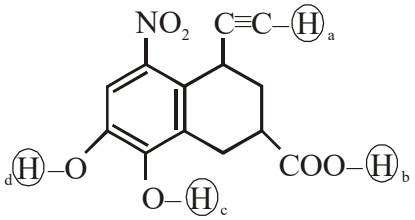
MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911
Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

JEE MAIN SEP 2020 | 2 SEP SHIFT-2

1. Arrange the following labelled hydrogens in decreasing order of acidity :



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

Ans. (1)

Sol. Carboxylic acid are most acidic followed by phenol and then alkyne

2. The one that is not expected to show isomerism is :

(1) $[Ni(NH_3)_2Cl_2]$ (2) $[Ni(NH_3)_4(H_2O)_2]^{2+}$ (3) $[Ni(en)_3]^{2+}$ (4) $[Pt(NH_3)_2Cl_2]$

Ans. (1)

Sol. (1) $[Ni(HN_3)_2Cl_2]$ is tetrahedral, does not show any isomerism.

(2) $[Ni(NH_3)_4(H_2O)_2]^{+2}$ is octahedral, show geometrical isomerism.

(3) $[Ni(en)_3]^{+2}$ is octahedral, show optical isomerism.

(4) $[Pt(NH_3)_2Cl_2]$ is square planar, show geometrical isomerism.

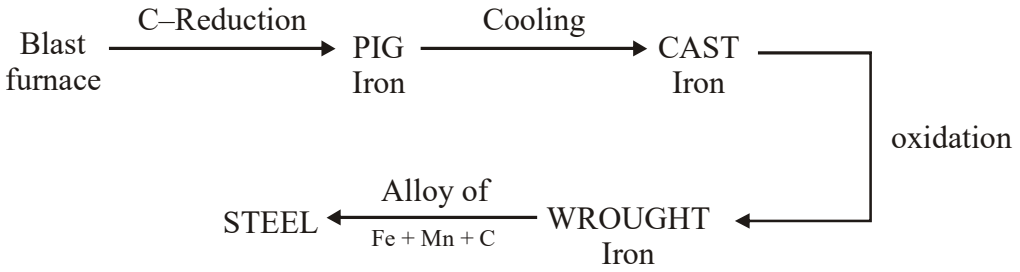
3. Cast iron is used for the manufacture of :

(1) wrought iron and steel (2) wrought iron, pig iron and steel

(3) pig iron, scrap iron and steel (4) wrought iron and pig iron

Ans. (1)

Sol.



4. The results given in the below table were obtained during kinetic studies of the following reaction :

$2A + B \rightarrow C + D$

Experiment	[A]/molL^{-1}	[B]/molL^{-1}	Initial rate/ molL^{-1} min^{-1}
I	0.1	0.1	6.00×10^{-3}
II	0.1	0.2	2.40×10^{-2}
III	0.2	0.1	1.20×10^{-2}
IV	X	0.2	7.20×10^{-2}
V	0.3	Y	2.88×10^{-1}

X and Y in the given table are respectively:

(1) 0.4, 0.3 (2) 0.3, 0.3 (3) 0.3, 0.4 (4) 0.4, 0.4

Ans. (3)

Sol. Rate = $k[A]^a [B]^b$

from Exp (1) & (2)

with respect to A order is 1

so a = 1

from Exp (1) & (3)

with respect to B order is 2

so b = 2

$r = k[A]^1 [B]^2$

in exp. 1

$6 \times 10^{-3} = k[0.1]^1 [0.1]^2$ .....(i)

in exp. 3

$7.2 \times 10^{-2} = k[X] [0.2]^2$ .....(ii)

divide (i) / (ii)

$$\frac{1}{12} = \frac{0.1}{X \times 4}$$

X = 0.3

from exp. 3

$2.4 \times 10^{-2} = k[0.1]\,[0.2]^2$

from exp. 5

$2.88 \times 10^{-1} = k[0.3]\,[Y]^2$

$$\frac{1}{12} = \frac{1}{3}\,\frac{4\times10^{-2}}{Y^2}$$

Y = 0.4

5. Amongst the following statements regarding adsorption, those that are valid are :

(a) ΔH becomes less negative as adsorption proceeds.

(b) On a given adsorbent, ammonia is adsorbed more than nitrogen gas.

(c) On adsorption, the residual force acting along the surface of the adsorbent increases.

(d) With increase in temperature, the equilibrium concentration of adsorbate increases.

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

Ans. (4)

Sol. When gas is adsorbed on metal surface then ΔH become less negative with progress of reaction.

Gas with greater value of critical temperature (T_c) is adsorbed more as $T_c(NH_3) > T_c(N_2)$

So NH_3 is adsorbed more than N_2.

6. Three elements X, Y and Z are in the 3rd period of the periodic table. The oxides of X, Y and Z, respectively, are basic, amphoteric and acidic. The correct order of the atomic numbers of X, Y and Z is :

(1) X < Z < Y (2) Y < X < Z (3) Z < Y < X (4) X < Y < Z

Ans. (4)

Sol. On moving left to right in a period. Acidic character of oxides is increase and atomic number also increases.

3rd period element oxides.

$\underbrace{Na_2O \quad MgO}_{\text{Basic}} \quad \underbrace{Al_2O_3}_{\text{Amphoteric}} \quad \underbrace{SiO_2 \quad P_2O_5 \quad Cl_2O_7}_{\text{Acidic}}$

So Z have maximum Atomic No

& X have minimum Atomic No

So correct order is X < Y < Z

7. The correct observation in the following reactions is :

$$\text{Sucrose} \xrightarrow[\text{Cleavage (Hydrolysis)}]{\text{Glycosidic bond}} A + B \xrightarrow[\text{reagent}]{\text{Seliwanoff's}} ?$$

(1) Formation of blue colour (2) Formation of violet colour

(3) Gives no colour (4) Formation of red colour

Ans. (4)

Sol. Seliwanoff reagent → [Resorchinol + Conc. HCl]

When a solution of ketohexose is heated with Seliwanoff's reagent, a red colour is developed. The test is given by ketohexoses and sucrose only but not by any aldose, lactose and maltose.

8. If you spill a chemical toilet cleaning liquid on your hand, your first aid would be :

(1) aqueous NaOH (2) aqueous NH_3

(3) vinegar (4) aqueous $NaHCO_3$

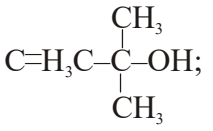
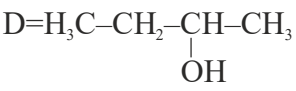
Ans. (4)

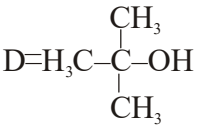
Sol. Chemical toilet cleaning liquid contains acid and hence the first aid would be a weak base like $NaHCO_3$.

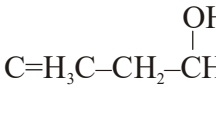
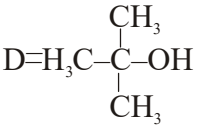
9. Two compounds A and B with same molecular formula (C_3H_6O) undergo Grignard's reaction with methylmagnesium bromide to give products C and D. Products C and D show following chemical tests.

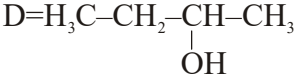
Test	C	D
Ceric ammonium nitrate Test	Positive	Positive
Lucas Test	Turbidity obtained after five minutes	Turbidity obtained immediately
Iodoform Test	Positive	Negative

C and D respectively are :

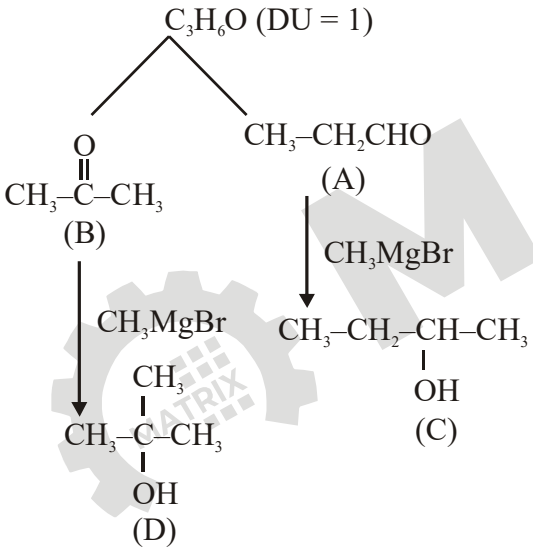
(1) C=  ; D= 

(2) C=$H_3C-CH_2-CH_2-CH_2-OH$; D= 

(3) C=  ; D= 

(4) C=$H_3C-CH_2-CH_2-CH_2-OH$; D= 

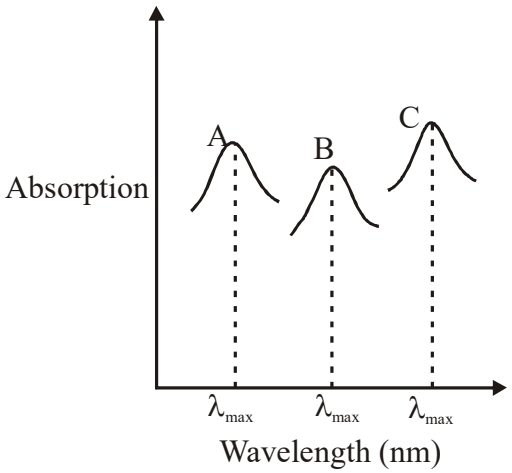
Ans. (3)

Sol. 

3º alcohol 2º alcohol

Ceric ammonium nitrate Test	+ve	+ve
Iodoform Test	–ve	+ve
Lucas Test	Immediate	after 5-10 minutes.
	[D]	[C]

10. Simplified absorption spectra of three complexes (i), (ii) and (iii) of M^{n+} ion are provided below; their λ_{max} values are marked as A, B and C respectively. The correct match between the complexes and their λ_{max} values is :



(i) $[M(NCS)_6]^{(-6+n)}$

(ii) $[MF_6]^{(-6+n)}$

(iii) $[M(NH_3)_6]^{n+}$

(1) A-(iii), B(i), C-(ii)

(2) A-(ii), B(i), C-(iii)

(3) A-(ii), B(iii), C-(i)

(4) A-(i), B(ii), C-(iii)

Ans. (1)

Sol. Stronger the ligand greater is splitting of d orbitals and smaller will be wave length of light absorbed.

the splitting power of ligands is $NH_3 > N\bar{C}S > F^-$

So order of wave length of light absorbed is $\lambda_{NH_3} < \lambda_{N\bar{C}S} < \lambda_F$

11. The number of subshells associated with n = 4 and m = –2 quantum numbers is :

(1) 8 (2) 16 (3) 2 (4) 4

Ans. (3)

Sol. If n = 4

Then possible no. of subshells = 4

Possible values of subshells $\Rightarrow$ l = 0, 1, 2, 3

but m = -2 can only possible for l = 2, 3 (4d, 4f)

So possible no. of subshells = 2

12. The major product obtained from E_2-elimination of 3-bromo-2-fluoropentane is :

(1) $CH_3–CH=CH–\underset{\displaystyle F}{\underset{|}{C}}H–CH_3$

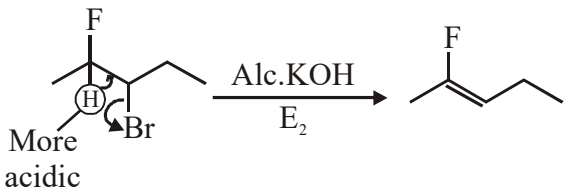
(2) $CH_3CH_2–\underset{\displaystyle Br}{\underset{|}{C}}H–CH=CH_2$

(3) $CH_3CH_2CH=\underset{\displaystyle CH_3}{\underset{|}{C}}–F$

(4) $CH_3–CH_2–\underset{\displaystyle Br}{\underset{|}{C}}=CH–CH_3$

Ans. (3)

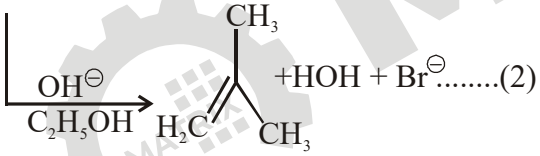
Sol. More acidic H is below F and more stable alkene is formed.



13. Consider the reaction sequence given below :

$$\text{Br} \xrightarrow{OH^{\ominus}} \text{OH} + Br^{\ominus} \quad .....(1)$$

$$\text{rate} = k[\text{t-BuBr}]$$



$$\text{rate} = k[\text{t-BuBr}][OH^{\ominus}]$$

Which of the following statements is true :

(1) Changing the concentration of base will have no effect on reaction (1).

(2) Changing the concentration of base will have no effect on reaction (2).

(3) Doubling the concentration of base will double the rate of both the reactions.

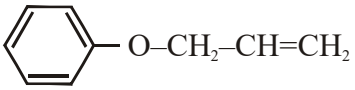
(4) Changing the base from $OH^{\ominus}$ to $^{\ominus}OR$ will have no effect on reaction (2).

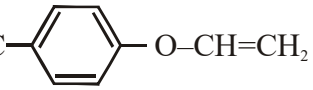
Ans. (1)

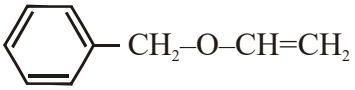
Sol. First reaction is S_N1 in which rate depends on conc. of alkyl halide and does not depend on conc. of nucleophile.

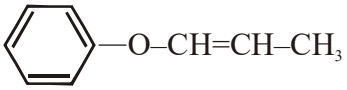
Second reaction is E2 reaction in which rate depends on conc. of base as well as conc. of alkyl halide.

14. An organic compound 'A' ($C_9H_{10}O$) when treated with conc. HI undergoes cleavage to yield compounds 'B' and 'C'. 'B' gives yellow precipitate with $AgNO_3$ where as 'C' tautomerizes to 'D'. 'D' gives positive iodoform test. 'A' could be :

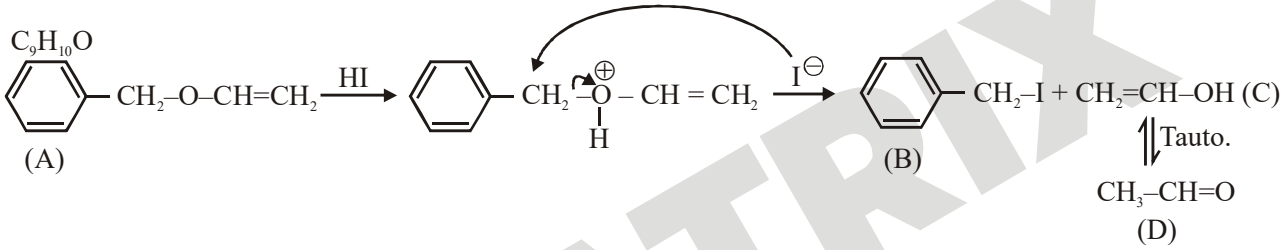
(1) 

(2) 

(3) 

(4) 

Ans.(3)

Sol. 

15. The shape/structure of $[XeF_5]^-$ and XeO_3F_2, respectively, are :

(1) pentagonal planar and trigonal bipyramidal

(2) Octahedral and square pyramidal

(3) trigonal bipyramidal and trigonal bipyramidal

(4) trigonal bipyramidal and pentagonal planar

Ans. (1)

Sol. (i) XeF_5^- St. No. = (5 + 2) = 7

So hybridisation is = sp^3d^3

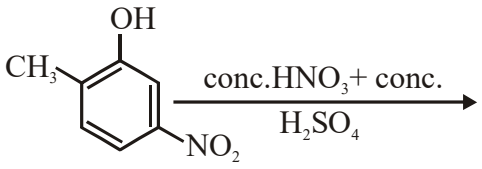
and structure is pentagonal planar.

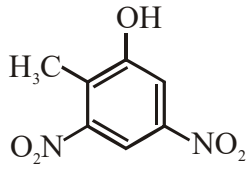
(ii) XeO_3F_2 St. No. = 5

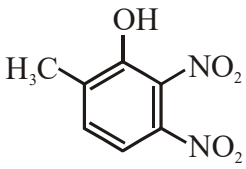
So hybridisation is = sp^3d

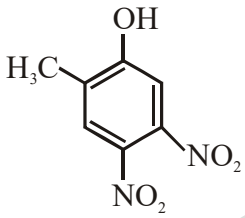
and structure is trigonal bipyramidal.

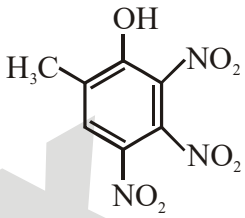
16. The major product of the following reaction is :



(1) 

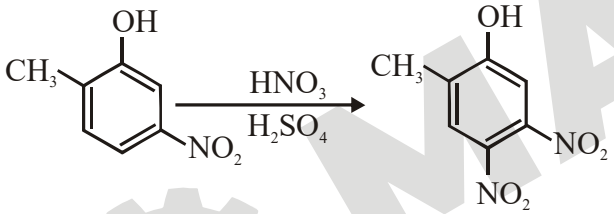
(2) 

(3) 

(4) 

Ans. (3)

Sol. This is electrophilic aromatic substitution reaction in which strong + R effect of OH directs the incoming electrophile.



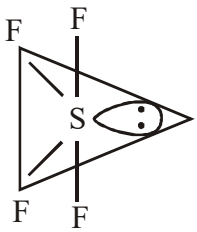
17. The molecular geometry of SF_6 is octahedral. What is the geometry of SF_4 (including lone pair(s) of electrons, if any) ?

(1) Pyramidal (2) Tetrahedral

(2) Trigonal bipyramidal (4) Square planar

Ans. (3)

Sol. $SF_4 \Rightarrow$ hybridisation is sp^3d and structure or electron pair geometry [including the lone pairs] is trigonal bipyramidal



18. The size of a raw mango shrinks to a much smaller size when kept in a concentrated salt solution. Which one of the following processes can explain this ?

(1) Reverse osmosis (2) Dialysis (3) Osmosis (4) Diffusion

Ans. (3)

Sol. When mango is kept in concentrated salt solution then solvent (water) flows from mango to concentrated solution that's why mango shrinks and this is known as "Osmosis".

19. Two elements A and B have similar chemical properties. They don't form solid hydrogencarbonates, but react with nitrogen to from nitrides. A and B, respectively, are :

(1) Na and Ca (2) Cs and Ba

(3) Li and Mg (4) Na and Rb

Ans. (3)

Sol. Li and Mg bicarbonates do not exist as solid form. But react with N_2 to give nitrides.

$$6Li + N_2 \xrightarrow{\Delta} 2Li_3N, \quad 3Mg + N_2 \xrightarrow{\Delta} Mg_3N_2$$

20. Match the type of interaction in column A with the distance dependence of their interaction energy in column B

A	B
(I) ion-ion	(a) $\frac{1}{r}$
(II) dipole-dipole	(b) $\frac{1}{r^2}$
(III) London dispersion	(c) $\frac{1}{r^3}$
	(d) $\frac{1}{r^6}$

(1) (I)-(a), (II)-(b), (III)-(d) (2) (I)-(a), (II)-(c), (III)-(d)

(3) (I)-(a), (II)-(b), (III)-(c) (4) (I)-(b), (II)-(d), (III)-(c)

Ans. (2)

Sol. (i) ion-ion interaction energy is inversely proportional to the distance between ions $\left(\frac{1}{r}\right)$.

(ii) dipole-dipole interaction energy is inversely proportional to the third power of $r\left(\frac{1}{r^3}\right)$

(iii) The interaction energy of London force is inversely proportional to sixth power of distance between two interaction particles $\left(\frac{1}{r^6}\right)$

21. For the disproportionation reaction $2\,Cu^{+}(aq) \rightleftharpoons Cu(s) + Cu^{2+}(aq)$ 298 K, *l*n K (where K is the equilibrium constant) is .....$\times 10^{-1}$

Given:

$(E^{0}_{Cu^{2+}/cu} = 0.16\,V$

$E^{0}_{Cu^{+}/cu} = 0.52\,V$

$\frac{RT}{F} = 0.025)$

Ans. 144

Sol. $E^{\circ}_{cell} = E^{\circ}_{Cu^{+}/Cu} - E^{\circ}_{Cu^{2+}/Cu^{+1}}$

$= 0.52 - 0.16$

$= 0.36\ V$

$\Delta G^{o} = -n\,F\,E^{o}_{cell} = -RT\,ln\,K_{eq}$

$l\,n\,K_{eq} = \frac{nF}{RT}E^{\circ}_{cell} \qquad (n = 1)$

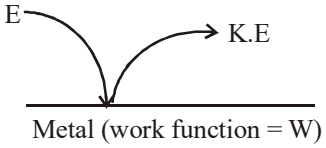
$ln\,K_{eq} = \frac{0.36}{.025}$

$= 14.4 = 144 \times 10^{-1}$

22. The work function of sodium metal is 4.41×10^{-19}J. If photons of wavelength 300nm are incident on the metal, the kinetic energy of the ejected electrons will be ($h = 6.63 \times 10^{-34}$J s; $c = 3 \times 10^{8}$ m/s) ____$\times 10^{-21}$J.

Ans. 222

Sol.



$E = W + (K.E)_{max}$

$$\frac{hC}{\lambda} = 4.41\times10^{-19} + (K.E)_{max}$$

$$\frac{6.63\times10^{-34}\times3\times10^{8}}{300\times10^{-9}} = 4.41\times10^{-19} + (K.E)_{max}$$

So, $(K.E)_{max} = 6.63 \times 10^{-19} - 4.41 \times 10^{-19}$

$= 2.22 \times 10^{-19}$

$= 222 \times 10^{-21}$ J

23. The ratio of the mass percentages of 'C & H' and 'C & O' of a saturated acyclic organic compound 'X' are 4 : 1 and 3 : 4 respectively. Then, the moles of oxygen gas required for complete combustion of two moles of organic compound 'X' is _____ .

Ans. 5

Sol. Mass ratio of C : H is $4 : 1 \Rightarrow 12 : 3$

& C : O is $3 : 4 \Rightarrow 12 : 16$

	mass	mole	mole ratio
so C	12	1	1
H	3	3	3
O	16	1	1

Empirical formula $\Rightarrow CH_3O$

as compound is saturated acyclic

D.U = 0

so molecular formula is $C_2H_6O_2$.

$$C_2H_6O_2 + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(g)$$

mole 2 mole 5 mole

so required moles of O_2 is $\Rightarrow 5$

24. The heat of combustion of ethanol into carbon dioxids and water is –327 kcal at constant pressure. The heat evolved (in cal) at constant volume and 27° C (if al gases behave ideally) is ($R = 2$ cal mol^{-1} K^{-1})_____.

Ans. 326400

Sol. $C_2H_5OH(l) + 3O_2(g) \rightarrow 2O_2(g) + 3H_2O(l)$.

$\Delta H_{Combustion} = -327$ Kcal

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

$\Delta H = -327 \times 10^3$ $\Delta n_g = -1$

$-327 \times 10^3 = \Delta U - 1 \times 2 \times 300$

$\Delta U = -326400$ cal

So heat evolved at constant volume is 326400 cal.

25. The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and K_2FeO_4, respectively, are x, y and z. The sum of x, y and z is _____.

Ans. 19

Sol.

	Compound	Oxidation state of transition element.
(i)	$K_2Cr_2O_7$	X = + 6
(ii)	$KMnO_4$	Y = + 7
(iii)	K_2FeO_4	Z = +6

so (X + Y + Z) = 19