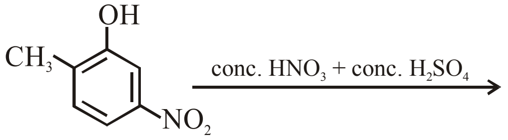
FINAL JEE–MAIN EXAMINATION – SEPTEMBER, 2020

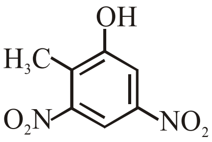
(Held On Wednesday 02nd SEPTEMBER, 2020) TIME : 3 PM to 6 PM

CHEMISTRY

TEST PAPER WITH ANSWER & SOLUTIONS

1. The major product of the following reaction is:



(1)


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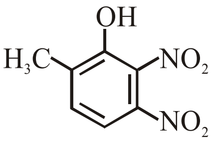

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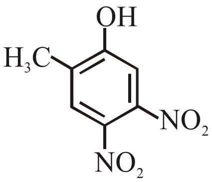
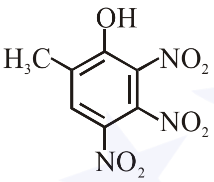
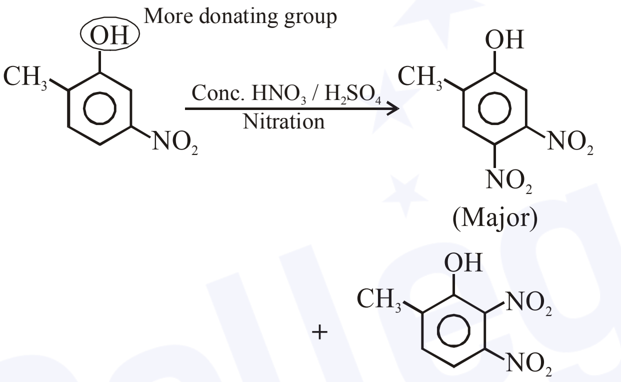


(4)


Official Ans. by NTA (3)

Sol.



[Minor due to crowding]

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

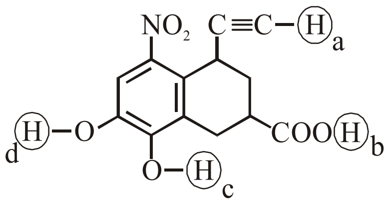
(1) aqueous NH_3 (2) vinegar

(3) aqueous $NaHCO_3$ (4) aqueous NaOH

Official Ans. by NTA (3)

Sol. Toilet cleaning liquid has about 10.5% w/v HCl; to neutralise its affect aqueous $NaHCO_3$ is used while NaOH is avoid for this purpose because its highly corosive in nature and can burn body.

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



(1) b > c > d > a

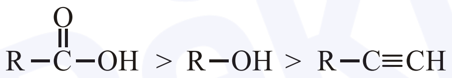
(2) c > b > a > d

(3) b > a > c > d

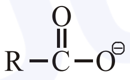
(4) c > b > d > a

Official Ans. by NTA (1)

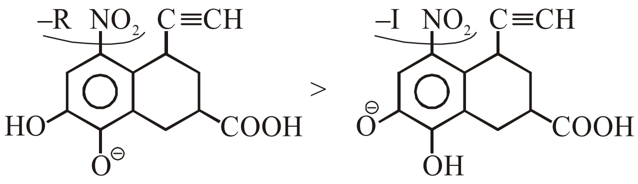
Sol. Acidic strength order :



$$R-\overset{\overset{O}{\|}}{C}-OH > R-OH > R-C\equiv CH$$

Reason :  $R-\overset{\overset{O}{\|}}{C}-O^{\ominus}$ stable by equivalent resonance.

Stable :



So answer is b > c > d > a.

4. Cast iron is used for the manufacture of :

(1) wrought iron and pig iron

(2) wrought iron and steel

(3) wrought iron, pig iron and steel

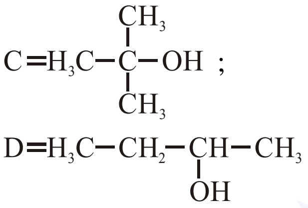
(4) pig iron, scrap iron and steel

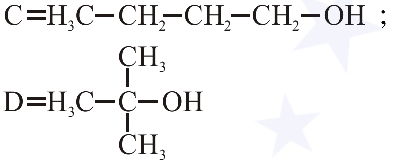
Official Ans. by NTA (2)

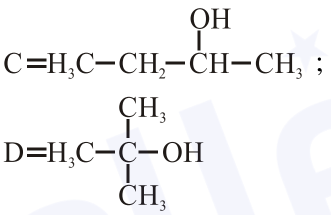
5. Two compounds A and B with same molecular formula (C_3H_6O) undergo Grignard's reaction with methylmagnesium bromide to give products C and D. Products C and D show following chemical tests.

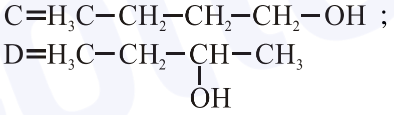
Test	C	D
Ceric ammonium nitrate Test	Positive	Positive
Lucas Test	Turbidity obtained after five minutes	Turbidity obtained immediately
Iodoform Test	Positive	Negative

C and D respectively are :

(1) 
$C=H_3C-\overset{CH_3}{\underset{CH_3}{C}}-OH$; $D=H_3C-CH_2-\underset{OH}{CH}-CH_3$

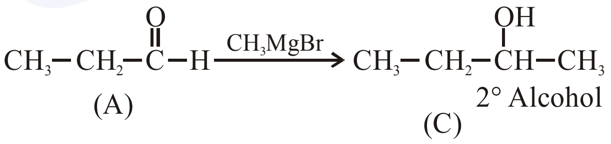
(2) 
$C=H_3C-CH_2-CH_2-CH_2-OH$; $D=H_3C-\overset{CH_3}{\underset{CH_3}{C}}-OH$

(3) 
$C=H_3C-CH_2-\overset{OH}{CH}-CH_3$; $D=H_3C-\overset{CH_3}{\underset{CH_3}{C}}-OH$

(4) 
$C=H_3C-CH_2-CH_2-CH_2-OH$; $D=H_3C-CH_2-\underset{OH}{CH}-CH_3$

Official Ans. by NTA (3)

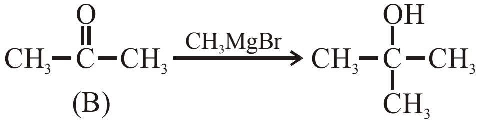
Sol.


$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H \xrightarrow{CH_3MgBr} CH_3-CH_2-\overset{OH}{CH}-CH_3$

(A) (C) 2° Alcohol

CAN test for alcohol : ✓

Iodoform test : ✓


$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{CH_3MgBr} CH_3-\overset{OH}{\underset{CH_3}{C}}-CH_3$

(B) 3° Alcohol

CAN test for alcohol : ✓

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

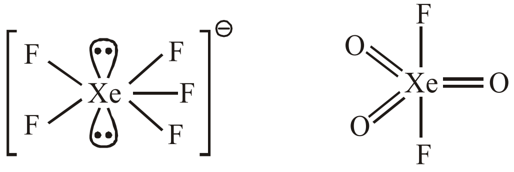
(1) pentagonal planar and trigonal bipyramidal

(2) trigonal bipyramidal and pentagonal planar

(3) octahedral and square pyramidal

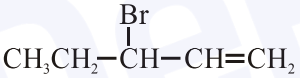
(4) trigonal bipyramidal and trigonal bipyramidal

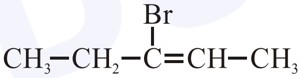
Official Ans. by NTA (1)

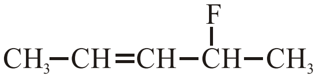
Sol. 

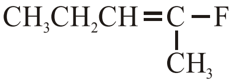
XeF_5^-	XeO_3F_2
sp^3d^3	sp^3d
Pentagonal planar	Trigonal bipyramidal

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

(1) 
$CH_3CH_2-\overset{Br}{CH}-CH=CH_2$

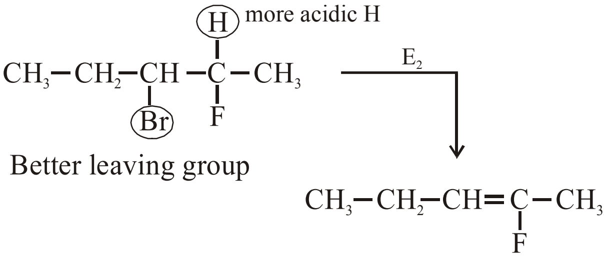
(2) 
$CH_3-CH_2-\overset{Br}{C}=CH-CH_3$

(3) 
$CH_3-CH=CH-\overset{F}{CH}-CH_3$

(4) 
$CH_3CH_2CH=\underset{CH_3}{C}-F$

Official Ans. by NTA (4)

Sol.


$CH_3-CH_2-\underset{Br}{CH}-\overset{H}{\underset{F}{C}}-CH_3 \xrightarrow{E_2} CH_3-CH_2-CH=\underset{F}{C}-CH_3$

Stable alkene having 5 αH

8. 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) $Z < Y < X$ (2) $X < Z < Y$

(3) $X < Y < Z$ (4) $Y < X < Z$

Official Ans. by NTA (3)

Sol. When we are moving from left to right in a periodic table acidic character of oxides increases (as well as atomic number of atom increases)

$\therefore$ $X < Y < Z$ (acidic character)

$X < Y < Z$ (atomic number)

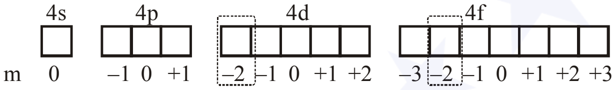
9. The number of subshells associated with n = 4 and m = –2 quantum numbers is :

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

Official Ans. by NTA (4)

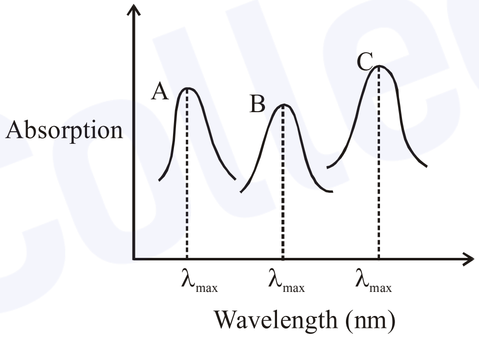
Sol. For $n = 4$

$\ell = 0, 1, 2, 3$



$\therefore$ 4d & 4f subshell associated with n = 4, m = –2

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

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

Official Ans. by NTA (2)

Sol. Strength of ligand $F^- < NCS^- < NH_3$

$[MF_6]^{(-6+n)}$ (ii) $[M(NCS)]^{(-6+n)}$ (i) $[M(NH_3)_6]^{n+}$ (iii)

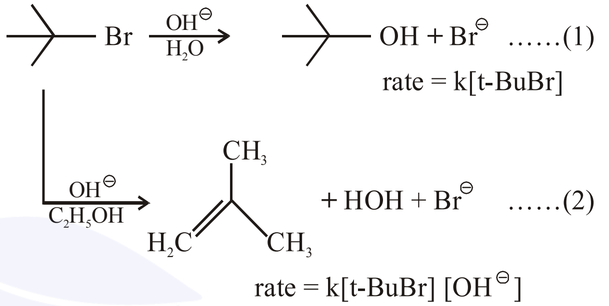
$\xrightarrow{\qquad\qquad\qquad\qquad} \Delta_{Oh}\uparrow$

$\xrightarrow{\qquad\qquad\qquad\qquad} \lambda_{max}\downarrow$

As given in graph : $A < B < C$ (λ_{max})

$\therefore$ Correct matching is A–(iii), B-(i), C-(ii)

11. Consider the reaction sequence given below :



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

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

Official Ans. by NTA (1)

Sol. Reaction 1 : SN_1

Reaction 2 : E_2

SN_1 is independent of concentration of nucleophile/base

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

$$2A + B \longrightarrow C + D$$

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) 0.3, 0.4 (2) 0.4, 0.3

(3) 0.4, 0.4 (4) 0.3, 0.3

Official Ans. by NTA (1)

Sol. From rate law

$$r = -\frac{1}{2}\frac{d[A]}{dt} = \frac{-d[B]}{dt}$$

$$= K[A]^x\ [B]^y$$

$6 \times 10^{-3} = K(0.1)^x\ (0.1)^y$ ……(1)

$2.4 \times 10^{-2} = K(0.1)^x\ (0.2)^y$ ……(2)

$1.2 \times 10^{-2} = K(0.2)^x\ (0.1)^y$ ……(3)

$(3) \div (1) \Rightarrow x = 1$

$(2) \div (3) \Rightarrow x = 2$

So, order with respect to A = 1

Order with respect to B = 2

$(4) \div (3)$

$$\left(\frac{x}{0.2}\right)\times\left(\frac{0.2}{0.1}\right)^2 = \frac{7.2\times10^{-2}}{1.2\times10^{-2}}$$

$$x = \frac{6\times0.2}{4}$$

$x = 0.3$ M

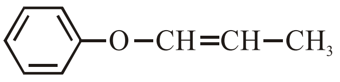
$(5) \div (4)$

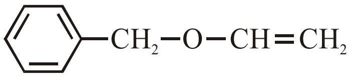
$$\left(\frac{y}{0.2}\right)^2 = \frac{2.88\times10^{-1}}{7.2\times10^{-2}}$$

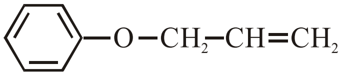
$y^2 = 4 \times 0.2^2$

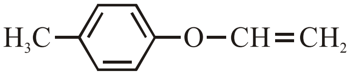
$y = 0.4$ M

13. 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 idoform test. 'A' could be :

(1)


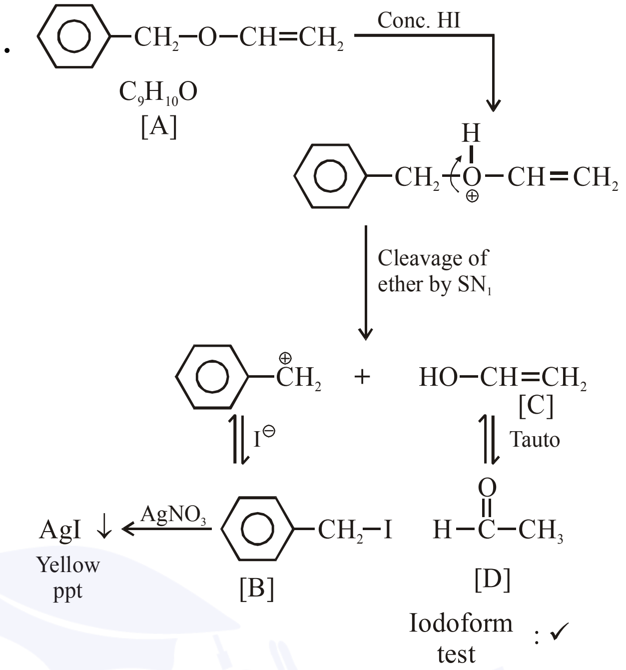
(2)


(3)


(4)


Official Ans. by NTA (2)

Sol



14. 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) Diffusion (2) Dialysis

(3) Osmosis (4) Reverse osmosis

Official Ans. by NTA (3)

Sol. Raw mango shrink in salt solution due to net transfer of water molecules from mango to salt solution due to phenomenon of osmosis.

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

(1) Na and C (2) Li and Mg

(3) Cs and Ba (4) Na and Rb

Official Ans. by NTA (2)

Sol. Both Li and Mg form nitride when reacts directly with nitrogen.

The hydrogen carbonate of both Li and Mg does not exist in solid state.

All alkali metal hydrogen carbonate exist in solid state except $LiHCO_3$.

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

(1) $[Ni(NH_3)_4(H_2O)_2]^{2+}$ (2) $[Ni(NH_3)_2Cl_2]$

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

Official Ans. by NTA (2)

Sol. $[Ni(NH_3)_2Cl_2]$ is tetrahedral complex, therefore does not show geometrical and optical isomerism.

$[Ni(NH_3)_2Cl_2]$ does not show structural isomerism

$[Ni(NH_3)_4(H_2O)_2]^{2+}$ & $[Pt(NH_3)_2Cl_2]$ show geometrical isomerism

$[Ni(en)_3]^{2+}$ show optical isomerism

17. 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) (b) and (c) (2) (a) and (b)

(3) (d) and (a) (4) (c) and (d)

Official Ans. by NTA (2)

Sol.(a) Since adsorption is exothermic process, as adsorption proceeds number of active sites present over adsorbent decreases, so less heat is evolved.

(b) Since NH_3 has higher force of attraction on adsorbent due to its polar nature (high value of 'a').

(c) As the adsorption increases, residual forces over surface decreases.

(d) Since process is exothermic, on increasing temperature it shift to backward direction, so concentration of adsorbate particle decreases.

18. 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)-(c)

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

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

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

Official Ans. by NTA (3)

Official Ans. by [redacted] **(2)**

Sol.

Type of interaction	Interaction Energy(E)
ion - ion	$E \propto \frac{1}{r}$
dipole - dipole	$E \propto \frac{1}{r^3}$
London dispersion	$E \propto \frac{1}{r^6}$

19. The correct observation in the following reactions is :

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

(1) Formation of blue colour

(2) Formation of violet colour

(3) Formation of red colour

(4) Gives no colour

Sol. Seliwanoff's test is used to distinguish between aldose and ketose sugars; when added to a solution containing ketose, red colour is formed rapidly.

$$\text{Sucrose} \xrightarrow{\text{Hydrolysis}} \underset{\text{Fructose}}{\overset{\text{Glucose}}{+}} \xrightarrow[\text{reagent}]{\text{Seliwanoff's}} \text{Red colour}$$

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

(1) Trigonal bipyramidal

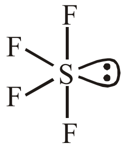
(2) Square planar

(3) Tetrahedral

(4) Pyramidal

Official Ans. by NTA (1)

Sol.



4σ bonds +1 lone pair

∴ Shape (including lone pair of electrons) is Trigonal bipyramidal

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

Official Ans. by NTA (–326400.00)

Official Ans. by [redacted] **(326400.00)**

Sol. $C_2H_5OH_{(\ell)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(\ell)}$

$\Delta n_g = 2 - 3 = -1$

$\Delta_c H = \Delta_c U + (\Delta n_g) RT$

$\Delta_c H = \Delta_c U - RT$

$\Delta_c U = \Delta_c H + RT$

$= -327 \times 10^3 + 2 \times 300$

$= -326400$ cal.

∴ Heat evolved

$= 326400$ cal.

22. For the disproportionation reaction $2Cu^+ (aq) \rightleftharpoons Cu(s) + Cu^{2+}(aq)$ at 298 K, ln K (where K is the equilibrium constant) is _____ × 10^{-1} .

Given

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

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

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

Official Ans. by NTA (144.00)

Sol.

$$\begin{array}{l} Cu^+ \longrightarrow Cu^{2+} + e^- \\ Cu^+ + e^- \longrightarrow Cu(s) \\ \hline 2Cu^+ \longrightarrow Cu^{2+} + Cu \end{array}$$

$$E^o_{cell} = E^o_{Cu^+/Cu} - E^o_{Cu^{2+}/Cu^+}$$

$= 0.52 - 0.16$

$= 0.36$ V

At equilibrium → $E_{cell} = 0$

$$E^o_{cell} = \frac{RT}{nF} \ln K$$

$$\ln K = \frac{E^o_{cell} \times nF}{RT}$$

$$\ln K = \frac{0.36 \times 1}{0.025}$$

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

23. 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 ____.

Official Ans. by NTA (19.00)

Sol. $K_2Cr_2O_7$

$2 (+1) + 2x + 7(-2) = 0$

$x = +6$

In $K_2Cr_2O_7$, Transition metal (Cr) present in +6 oxidation state.

$KMnO_4$

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

$x = +7$

In $KMnO_4$, transition metal (Mn) present in +7 oxidation state

K_2FeO_4

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

$x = +6$

In K_2FeO_4 , transition metal (Fe) present in +6 oxidation state

So, $x = +6$

$y = +7$

$z = +6$

$$\overline{x + y + z = 19}$$

24. 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 _______ .

Official Ans. by NTA (5.00)

Sol. C : H = 4 : 1

C : O = 3 : 4

Mass ratio

C : H : O = 12 : 3 : 16

Mole ratio

C : H : O = 1 : 3 : 1

Empirical formula = CH_3O

Molecular formula = $C_2H_6O_2$

(saturated acyclic organic compound)

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

2 mole 5 mol

Moles of O_2 required = 5 moles

25. The work function of sodium metal is 4.41×10^{-19} J. If the photons of wavelength 300 nm are incident on the metal, the kinetic energy of the ejected electrons will be ________ $\times 10^{-21}$ J.

($h = 6.63 \times 10^{-34}$ Js; $c = 3 \times 10^8$ m/s)

Official Ans. by NTA (222.00)

Sol. $E = W + K{\cdot}E_{max}$

$K{\cdot}E_{max} = E - W$

$$= \frac{hc}{\lambda} - 4.41 \times 10^{-19}$$

$$= \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{300 \times 10^{-9}} - 4.41 \times 10^{-19}$$

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

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