JEE Main September 2020

Question Paper With Text Solution

6 September| Shift-2

CHEMISTRY

MATRIX

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

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JEE MAIN SEP 2020 | 6 Sep. SHIFT-2

1. Match the following compounds (Column-I) with their uses (Column-II) :

S. No.	Column – I	S. No.	Column – II
(I)	$Ca(OH)_2$	(A)	casts of statues
(II)	NaCl	(B)	white wash
(III)	$CaSO_4 \cdot \frac{1}{2} H_2O$	(C)	antacid
(IV)	$CaCO_3$	(D)	washing soda preparation

(1) (I)-(C), (II)-(D), (III)-(B), (IV)-(A)

(2) (I)-(B), (II)-(D), (III)-(A), (IV)-(C)

(3) (I)-(D), (II)-(A), (III)-(C), (IV)-(B)

(4) (I)-(B), (II)-(C), (III)-(D), (IV)-(A)

Ans (2)

Sol. (I) $Ca(OH)_2$ is used in white wash

(II) NaCl is used in preparation of washing soda

$2NH_3 + H_2O + CO_2 \longrightarrow (NH_4)_2CO_3$

$(NH_4)_2CO_3 + H_2O + CO_2 \longrightarrow 2NH_4HCO_3$

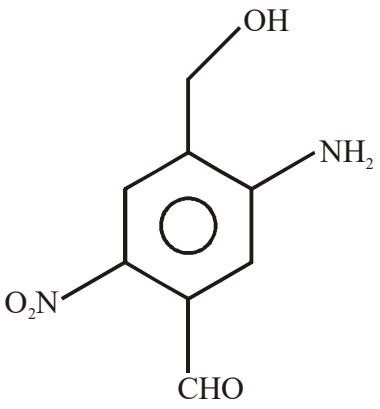
$NH_4HCO_3 + NaCl \longrightarrow NH_4Cl + NaHCO_3(s)$

$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$

(III) $CaSO_4 . \frac{1}{2} H_2O$ (Plaster of Paris) is used for making casts of statues

(IV) $CaCO_3$ is used as an antacid

2. The IUPAC name of the following compound is :



(1) 3-amino-4-hydroxymethyl-5-nitrobenzaldehyde

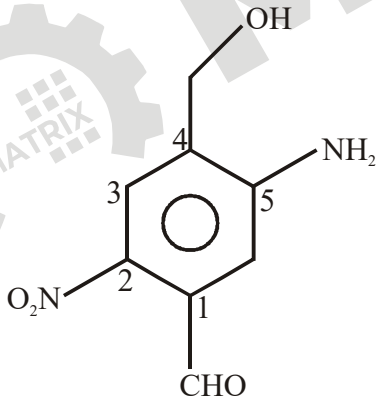
(2) 4-amino-2-formyl-5-hydroxymethyl nitrobenzene

(3) 2-nitro-4-hydroxymethyl-5-amino benzaldehyde

(4) 5-amino-4-hydroxymethyl-2-nitrobenzaldehyde

Ans (4)

S.



5-Amino-4-(hydroxymethyl)-2-nitro benzene carbaldehyde.

3. The correct match between Item - I and Item - II is :

Item - I		**Item - II**	
(a)	Natural rubber	(I)	1, 3-butadiene + styrene
(b)	Neoprene	(II)	1, 3-butadiene + acrylonitrile
(c)	Buna-N	(III)	Chloroprene
(d)	Buna-S	(IV)	Isoprene

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

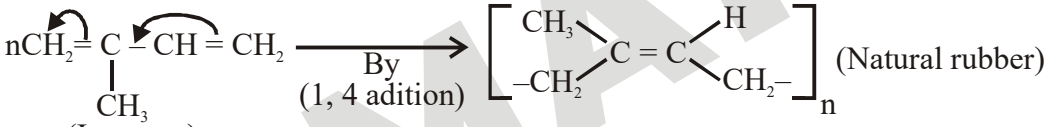
(2) (a) - (IV), (b) - (III), (c) - (I), (d) - (II)

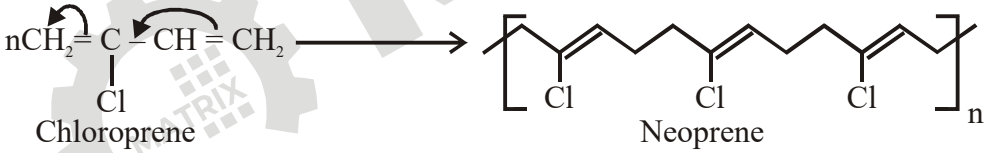
(3) (a) - (III), (b) - (IV), (c) - (I), (d) - (II)

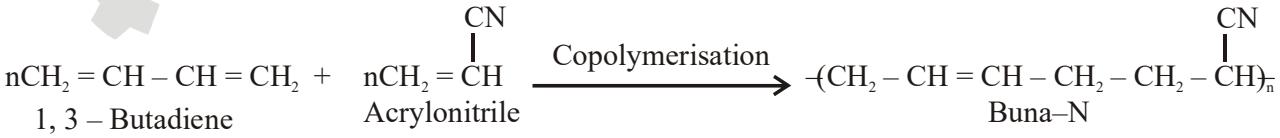
(4) (a) - (III), (b) - (IV), (c) - (II), (d) - (I)

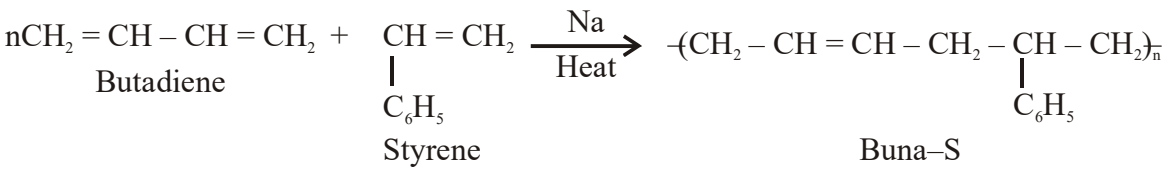
Ans (1)

S.









4. For a reaction, $4\,M(s) + n\,O_2(g) \rightarrow 2\,M_2O_n(s)$, the free energy change is plotted as a function of temperature. The temperature below which the oxide is stable could be inferred from the plot as the point at which :

(1) the slope changes from positive to negative

(2) The free energy changes shows a change from negative to positive value

(3) the slope changes from negative to positive

(4) the slope changes from positive to zero

Ans (2)

S. For oxide to be stable if its ΔG value should be negative.

5. The reaction of NO with N_2O_4 at 250 K gives :

(1) N_2O (2) N_2O_5 (3) NO_2 (4) N_2O_3

Ans (4)

S. $2NO + N_2O_4 \xrightarrow{250\,K} \underset{\text{Blue solid}}{N_2O_3}$

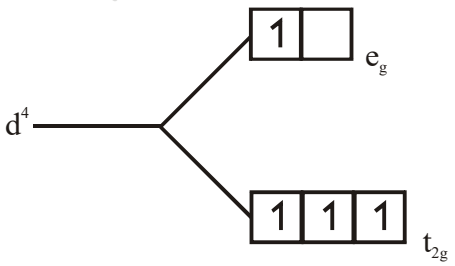
6. For a d^4 metal ion in an octahedral field, the correct electronic configuration is :

(1) $t_{2g}^4 e_g^0$ When $\Delta_0 < P$ (2) $t_{2g}^3 e_g^1$ When $\Delta_0 > P$

(3) $e_g^2 t_{2g}^2$ When $\Delta_0 < P$ (4) $t_{2g}^3 e_g^1$ When $\Delta_0 < P$

Ans (4)

S.



For d^4 configuration if $\Delta_0 < P$ the electronic configuration is $t_{2g}^3\, e_g^1$.

7. A crystal is made up of metal ions 'M_1' and 'M_2' and oxide ions. Oxide ions form a ccp lattice structure. The cation 'M_1' occupies 50% of octahedral voids and the cation 'M_2' occupies 12.5% of tetrahedral voids of oxide lattice. The oxidation numbers of 'M_1' and 'M_2' are, respectively :

(1) +4, +2 (2) +3, +1

(3) +1, +3 (4) +2, +4

Ans (4)

S. In the ccp lattice of oxide ions effective number of O^{-2} ions $= 8\times\frac{1}{8}+6\times\frac{1}{2}=4$

In the ccp lattice,

No. of octahedral voids = 4

No. of tetrahedral voids = 8

Given M_1 atoms occupies 50% of octahedral voids and M_2 atoms occupies 12.5 of tetrahedral voids

No. of M_1 metal atoms $= 4\times\frac{50}{100}=2$

No. of M_2 metal atoms $= 8\times\frac{12.5}{100}=1$

$\therefore$ Formula of the compound $= (M_1)_2(M_2)O_4$

This must be neutral. Both metals must have +8 charge in total.

From given options oxidation states of metals M_1 & M_2 respectively are +2 and +4.

8. The average molar mass of chlorine is 35.5 g mol^{-1}. The ratio of ^{35}Cl to ^{37}Cl in naturally occurring chlorine is close to :

(1) 4 : 1 (2) 1 : 1 (3) 3 : 1 (4) 2 : 1

Ans (3)

S. ^{35}Cl ^{37}Cl

Molar ratio x 1 – x

$M_{avg.} = 35 \times x + 37(1 - x) = 35.5$

$35x + 37 - 37x = 35.5$

$2x = 1.5$

$x = \frac{3}{4}$

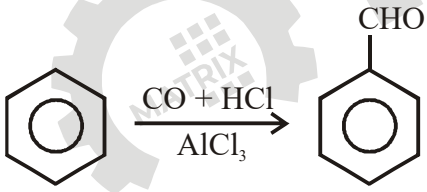
So, ratio of $^{35}Cl : {}^{37}Cl = 3 : 1$

9. The correct match between Item - I (starting material) and Item - II (reagent) for the preparation of benzaldehyde is :

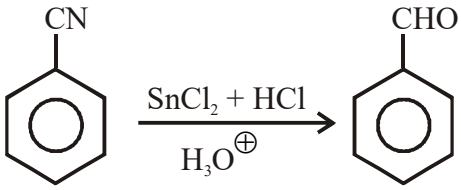
Item - I	**Item - II**
(I) Benezene	(P) HCl and $SnCl_2$, H_3O^+
(II) Benzonitrile	(Q) H_2, Pd-$BaSO_4$, S and quinoline
(III) Benzoyl chloride	(R) CO, HCl and $AlCl_3$

(1) (I) - (P), (II) - (Q) and (III) - (R)
(2) (I) - (R), (II) - (Q) and (III) - (P)
(3) (I) - (R), (II) - (P) and (III) - (Q)
(4) (I) - (Q), (II) - (R) and (III) - (P)

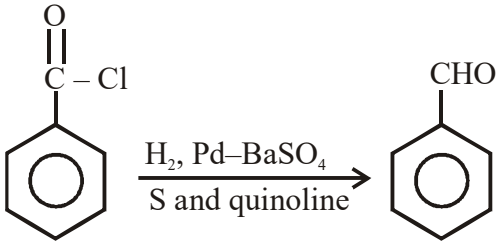
Ans (3)

S. 

Gatterman-Koach reaction



Stephen Reduction



Rosenmund Reduction

10. Which one of the following statements is not true?

(1) Lactose contains α -glycosidic linkage between C_1 of galactose and C_4 of glucose.

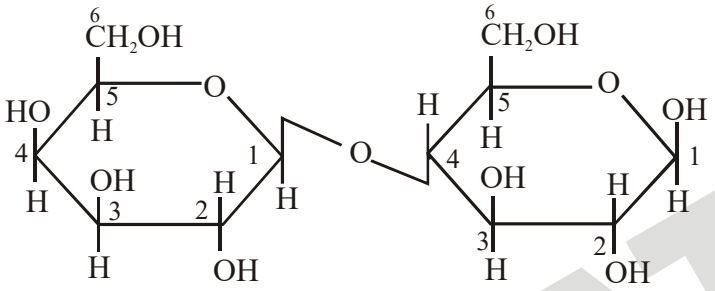
(2) Lactose ($C_{11}H_{22}O_{11}$) is a disaccharide and it contains 8 hydroxyl groups.

(3) On acid hydrolysis, lactose gives one molecule of D(+)-glucose and one molecule of D(+)-galactose.

(4) On acid hydrolysis, lactose gives one molecule of D(+)-glucose and one molecule of D(+)-galactose.

Ans (1)

S.



The linkage is between C–1 of Galactose and C–4 of Glucose

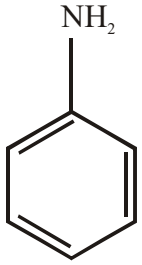
Lactose (Milk sugar) $\xrightarrow{H_3O^{\oplus}}$ β-galactose + β-glucose

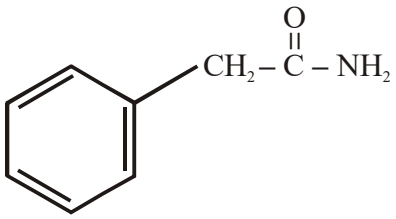
($C_{12}H_{22}O_{11}$)

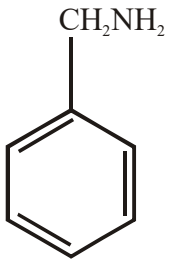
It is hydrolysed by dilute acids or by the enzyme lactase, to an equimolecular mixture of D(+)–glucose and D(+)–galactose. Lactose is a reducing sugar.

11. Which of the following compounds can be prepared in good yield by Gabriel phthalimide synthesis?

(1) $CH_3 - CH_2 - NHCH_3$

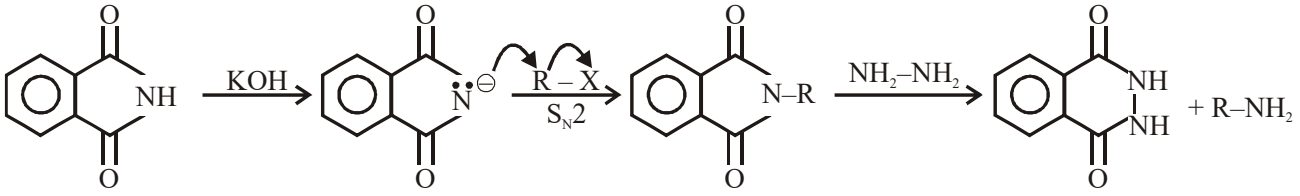
(2) 

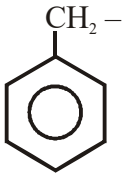
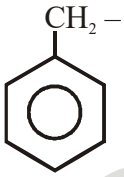
(3) 

(4) 

Ans (4)

S. From Gabriel phthalimide reaction, 1° Amine can be prepared.



Here R – Br =  ; R – NH_2 = 

12. Mischmetal is an alloy consisting mainly of :

(1) actinoid metals (2) lanthanoid and actinoid metals

(3) lanthanoid metals (4) actinoid and transition metals

Ans (3)

S. Misch metal consists of Lanthanide metal (≈95%) and iron (≈5%) and traces of S, C, Ca and Al.

13. The element that can be refined by distillation is :

(1) nickel (2) gallium (3) tin (4) zinc

Ans (4)

S. Zn, Cd & Hg are purified by fractional distillation process.

14. A set of solutions is prepared using 180 g of water as a solvent and 10 g of different non-volatile solutes A, B and C. The relative lowering of vapour pressure in the presence of these solutes are in the order [Given, molar mass of A = 100 g mol^{-1}; B = 200 g mol^{-1}; C = 10,000 g mol^{-1}]

(1) C > B > A (2) B > C > A (3) A > C > B (4) A > B > C

Ans (4)

S. Relative lowering in vapour pressure depends on no. of mole of solute,

Greater the no. of mole of solute greater the RLVP and smaller will be vapour pressure.

So order of vapour pressure is A > B > C.

15. The value of K_C is 64 at 800 K for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ The value of K_C for the following reaction is :

$$NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$$

(1) 1/64 (2) 1/8 (3) 8 (4) 1/4

Ans (2)

S. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

$$K_C = \frac{[NH_3]^2}{[N_2][H_2]^3} = 64$$

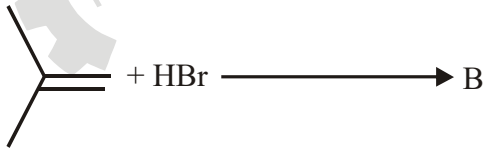
For the reaction

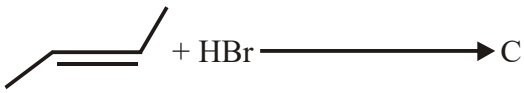
$$NH_3(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{3}{2}H_2(g)$$

$$K'_C = \frac{[N_2]^{1/2}[H_2]^{3/2}}{[NH_3]} = \frac{1}{\sqrt{K_C}} = \frac{1}{\sqrt{64}} = \frac{1}{8}$$

16. The increasing order of the boiling points of the major products A, B and C of the following reactions will be :

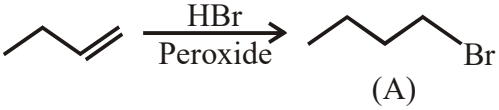
(a) 

(b) 

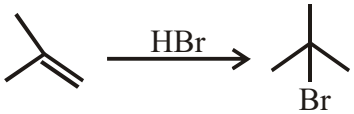
(c) 

(1) A < B < C (2) C < A < B (3) B < C < A (4) A < C < B

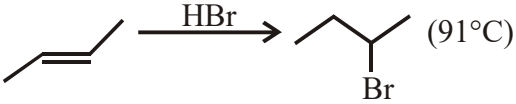
Ans (3)

S. (a) 

(102°C)
(A)

(b) 

(73.3°C)
(B)

(c) 

(91°C)
(C)

The boiling points of isomeric halo alkanes decrease with increase in branching.

17. Dihydrogen of hight purity (> 99.95%) is obtained through :

(1) the electrolysis of warm $Ba(OH)_2$ solution using Ni electrodes.

(2) the electrolysis of brine solution.

(3) the reaction of Zn with dilute HCl.

(4) the electrolysis of acidified water using Pt electrodes.

Ans (1)

S. Dihydrogen of high degree of purity (> 99.95%) is obtained by the electrolysis of warm aqueous barium hydroxide solution between nickel electrodes.

18. Reaction of an inorganic sulphite X with dilute H_2SO_4 generates compound Y. Reaction of Y with NaOH gives X. Further, the reaction of X with Y and water affords compound Z. Y and Z, respectively, are :

(1) SO_2 and Na_2SO_3 (2) S and Na_2SO_3 (3) SO_2 and $NaHSO_3$ (4) SO_3 and $NaHSO_3$

Ans (3)

S. $\underset{'X'}{Na_2SO_3} \xrightarrow{dil.H_2SO_4} \underset{'Y'}{SO_2} \xrightarrow{NaOH} \underset{'X'}{Na_2SO_3} \xrightarrow{SO_2+H_2O} \underset{'Z'}{NaHSO_3}$

19. Match the following :

	Test/Method		**Reagent**
(i)	Lucas Test	(a)	$C_6H_5SO_2Cl$ / aq. KOH
(ii)	Dumas method	(b)	HNO_3 / $AgNO_3$
(iii)	Kjeldahl's method	(c)	CuO / CO_2
(iv)	Hinsberg Test	(d)	Conc. HCl and $ZnCl_2$
		(e)	H_2SO_4

(1) (i)-(d), (ii)-(c), (iii)-(b), (iv)-(e)

(2) (i)-(b), (ii)-(a), (iii)-(c), (iv)-(d)

(3) (i)-(d), (ii)-(c), (iii)-(e), (iv)-(a)

(4) (i)-(b), (ii)-(d), (iii)-(e), (iv)-(a)

Ans (3)

S. (I) Lucas reagent $\rightarrow$ $ZnCl_2$/Conc. HCl

(II) Dumas method $\rightarrow$ CuO/Δ

(III) Kjeldahl's method $\rightarrow$ Conc. H_2SO_4/Δ

(IV) Hinsberg reagent $\rightarrow$ C_6H_5 SO_2Cl / aq.NaOH

20. For the given cell ;

$Cu(s)|Cu^{2+}(C_1\ M)||Cu^{2+}(C_2\ M)|Cu(s)$

change in Gibbs energy (ΔG) is negative, if :

(1) $C_1 = C_2$ (2) $C_2 = C_1/\sqrt{2}$ (3) $C_1 = 2\ C_2$ (4) $C_2 = \sqrt{2}\ C_1$

Ans (4)

S. For concentration cell $E°_{cell} = 0$

Anode : $Cu(s) \longrightarrow Cu^{2+}(C_1) + 2e^-$

Cathode : $Cu^{2+}(C_2) + 2e^- \longrightarrow Cu(s)$

Overall : $Cu^{2+}(aq) \longrightarrow Cu^{2+}(aq)$

As $\Delta G = -nF\, E_{cell}$

If $\Delta G = -ve$ then E_{cell} is positive.

$$E_{cell} = E^o_{cell} - \frac{0.059}{2}\log\frac{C_1}{C_2}$$

$$E_{cell} = \frac{-0.059}{2}\log\frac{C_1}{C_2}$$

$E_{cell} > 0 \quad \Rightarrow C_2 > C_1$

21. If the solubility product of AB_2 is $3.20 \times 10^{-11}\ M^3$, then the solubility of AB_2 in pure water is _____ $\times 10^{-4}$ mol L^{-1}. [Assuming that neither kind of ion reacts with water]

Ans (2)

S. $AB_2 \rightleftharpoons A^{2+} + 2B^-$

s 2s

$K_{sp} = 4s^3 = 3.20 \times 10^{-11}$

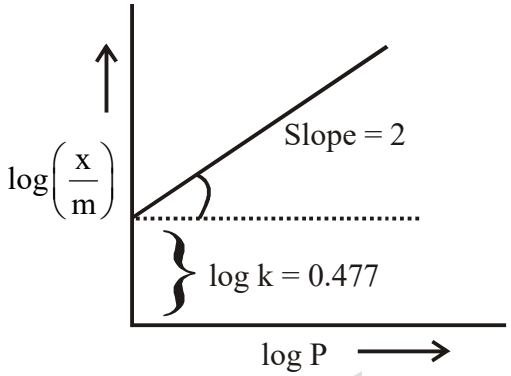
So solubility $= 2 \times 10^{-4}$ mol L^{-1}

22. For Freundlich adsorption isotherm, a plot of log (x / m) (y-axis) and log p (x-axis) gives a straight line. The intercept and slope for the line is 0.4771 and 2, respectively. The mass of gas, adsorbed per gram of adsorbent if the initial pressure is 0.04 atm, is _____ $\times 10^{-4}$g. (log 3 = 0.4771)

Ans (48)

S. $\left(\frac{x}{m}\right) = k(P)^{\frac{1}{n}}$

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



$\text{Slope} = \frac{1}{n} = 2 \qquad \text{So } n = \frac{1}{2}.$

Intercept $\Rightarrow$ logk = 0.477. So k = Antilog (0.477) = 3

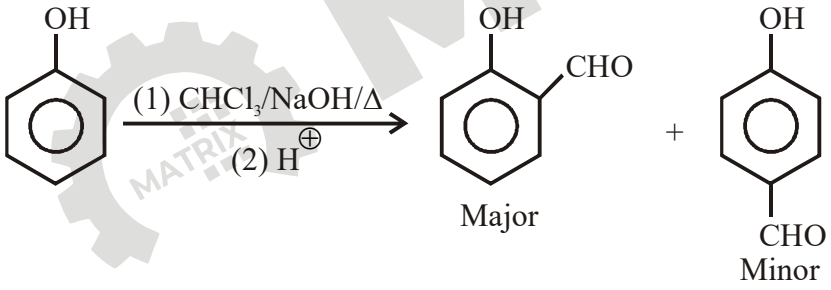
So $\left(\frac{x}{m}\right) = k(P)^{\frac{1}{n}}$

$= 3[0.04]^2 = 48 \times 10^{-4}$.

23. A solution of phenol in chloroform when treated with aqueous NaOH gives compound P as a major product. The mass percentage of carbon in P is _____. (to the nearest integer)
(Atomic mass : C = 12; H = 1; O = 16)

Ans (69)

S. **Reimer-Tiemann formylation reaction :**



Molecular formula of product is $C_7H_6O_2$

Percentage weight of carbon = $\left(\frac{84}{122} \times 100\right) = 68.85\%$

24. The atomic number of Unnilunium is _____.

Ans (101)

S. According to IUPAC convention for naming of elements with atomic number more than 100, different digits are written in order and at the end ium is added. For digits following naming is used.

0-nil

1-un

2-bi

3-tri

and so on…

25. The rate of a reaction decreased by 3.555 times when the temperature was changed from 40 ºC to 30 ºC. The activation energy (in kJ mol^{-1}) of the reaction is _____. Take; R = 8.314 J mol^{-1} K^{-1} In 3.555 = 1.268

Ans (100)

S. $$\log\left(\frac{k_2}{k_1}\right)=\frac{Ea}{2.303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$$

$$\log(3.555)=\frac{Ea}{2.303R}\left[\frac{1}{303}-\frac{1}{313}\right]$$

$1.268 \times 8.314 \times 303 \times 313 = 10\ Ea$

So, Ea = 100 kJ