LALAN'S COACHING

LAITS PART TEST 1 CHEMISTRY JEE MAIN ON 13TH DECEMBER

DATE: 10-12-2020 **TIME:** 60mins

Marking scheme

Numeric type: +4, -1

Numeric Questions

1 **A crystal is made up of atoms X, Y & Z. Atoms, X are in FCC packing. Y occupies all octachedral voids and Z occupies all tetrahedral voids. If all the atoms along two body diagonals are removed, the ratio of sum of effective numbers of atoms of Y and Z to the effective member of atoms of X is x : 1, what is the value of x?**

Answer: 2

Solution:

$$\text{Effective number of atoms of } X = 4 - 4 \times \frac{1}{8} = 3.5$$

$$\text{Effective number of atoms of } Y = 4 - 1 = 3$$

$$\text{Effective number of atoms of } Z = 8 - 4 = 4$$

$$\text{Ans} : \frac{3+4}{7/2} = 2$$

2 **In a hexagonal closest packing in two layers one above the other, the coordination number of each sphere will be**

Answer: 9

Solution:

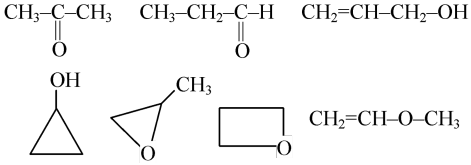
6 in a layer and 3 from upper layer

3 **How many structural isomers possible of the molecular formula C_3H_6O (excluding enol form)**

Answer: 7

Solution:

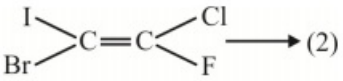
Total = 7

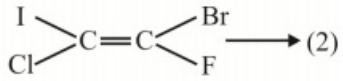


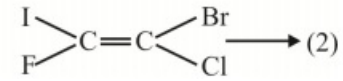
4 **Number of geometrical isomers formed from C_2 (Cl) (Br) (I)(F)**

Answer: 6

Solution:







5

Density of equilibrium mixture of N_2O_4 and NO_2 at 1 atm and 384 K is $1.84\,g.dm^{-3}$. What is the equilibrium constant, Kp for decomposition of N_2O_4 to the nearest integer?

Answer: 2

Solution:

$$PM_{av} = dRT$$

$$M_{av} = \frac{d}{P}RT = \frac{1.84 \times 0.0821 \times 384}{1} = 58$$

$$\text{Vapour density at equn.} = \frac{58}{2} = 29$$

$$\text{Initial vapour density} = \frac{92}{2} = 46$$

$$\therefore x = \frac{D-d}{(n-1)d} = \frac{46-29}{29} = \frac{17}{29} = 0.586$$

$$Kp = 2.09\,atm \square\ 2.0\,atm$$

Single Correct Questions

6 **If for the equilibrium :the value of Kp at 800 K is 27 x $2^{\lambda/2}$ and the equilibrium pressure is 22 atm value of λ is :**

$$NH_2COONH_4(s) \rightleftharpoons N_2(g) + 3H_2(g) + CO(g) + \frac{1}{2}O_2(g)$$

Correct Options:

(B) 21

Solution:

$$NH_2COONH_4(s) \rightleftharpoons N_2(g) + 3H_2(g) + CO(g) + \frac{1}{2}O_2(g)$$

$$p \qquad 3p \qquad p \qquad \frac{p}{2}$$

Total pressure at equilibrium = 22 atm

$$p + 3p + p + \frac{p}{2} = 22$$

$$\Rightarrow \frac{11}{2} = 22 \qquad \Rightarrow p = 4 \text{ atm}$$

$$Kp = p(3p)^3\, p\, \sqrt{\frac{p}{2}} = 27 \times p^{11/2} \qquad 2^{-1/2}$$

$$\Rightarrow 27 \times 2^{\lambda/2} = 27\,(4)^{11/2}\, 2^{-1/2}$$
$$\Rightarrow 2^{\lambda/2} = 2^{21/2}$$
$$\lambda = 21$$

7 **The equilibrium constant Kc for the reaction,** $A(g) + 2B(g) \rightleftharpoons 3C(g)$ **is** 2×10^{-3} **What would be the equilibrium partial pressure of gas C if initial pressure of gas A & B are 1 & 2 atm respectively.**

Correct Options:

(B) 0.1875 atm

Solution:

$A(g) + 2B(g) \rightleftharpoons 3C(g)$ $K_p = 2\times10^{-3}$

	1	2	0
At eq.	1–x	2–2x	3x

$$K_p = \frac{[C]^3}{[B]^2\,[A]} \Rightarrow \frac{(3x)^3}{(2-2x)^2\,(1-x)}$$

$$2 \times 10^{-1} = \frac{3x}{(1-x)}$$

$$.2\,(1-x) = 3x$$

$$.2 = 3x + .2x$$

$$\Rightarrow x = \frac{0.2}{3.2} = \frac{1}{16}$$

Now $P_C = 3x$

$$= 3 \times \frac{1}{16}$$

$$\Rightarrow \frac{3}{16} \Rightarrow 0.1875$$

$$K_p \Rightarrow \frac{(3x)^3}{4(1-x)^3} \qquad .....(1)$$

as $k_p = 2 \times 10^{-3}$

$2 \times 10^{-3} \times 4 = d$

$$\Rightarrow 2\times10^{-3}\times4 = \frac{(3x)^3}{(1-x)^3}$$

8 **For the reaction :** $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$ $K_c = 1.8 \times 10^{-6}$ **at 184° C and R = 0.083 JK^{-1} mol^{-1}. When K_p and Kc are compared at 184°C, it is found that :**

Correct Options:

(A) $K_p > K_c$

Solution:

Given :- $2NO_2 \rightleftharpoons 2NO + O_2$ $K_e = 1.8\times10^{-6}$
(g) (g) (g)

T = 184°C
= (184 + 273)K $\Rightarrow$ 475 K

$R = 0.083\ J\ K^{-1}\ mol^{-1}$

Now, $\Delta n_g = 3 - 2 \Rightarrow 1$

$$Kp = K_C\,(RT)^{\Delta n_g}$$

$$\frac{K_P}{K_C} = 0.0821 \times 457$$

$Kp = K_C (RT)^1 \quad \Rightarrow \frac{K_P}{K_C} = (RT)^1$ $\frac{K_P}{K_C} > 1$

$\Rightarrow K_p > K_c$

9 **The equilibrium constant for the reaction** $A(g) + 2B(g) \rightleftharpoons C(g)$ **is 0.25 dm^6 mol^{-2}. In a volume of 5 dm^3, what amount of A must be mixed with 4 mol of B to yield 1 mol of C at equilibrium.**

Correct Options:

(C) 26 moles

Solution:

Given :- reaction

$[A] = \frac{a-1}{5}$ $[B] = \frac{2}{5}$, $[C] = \frac{1}{5}$

$A(g) + 2B(g) \rightleftharpoons C(g)$	(at equill.)	a–x	4–2x	x
a 4 0	as x = 1	A(g) = a – 1,	B(g)=2,	C(g)=1

$K_C = \frac{(1/5)}{\left(\frac{2}{5}\right)^2\left(\frac{a-1}{5}\right)}$ $K_C = \frac{25}{4(a-1)}$ ....(1)

as $K_C = 0.25$ ....(2)

from (1) & (2)

$.25 = \frac{25}{4(a-1)}$

$\Rightarrow 4(a-1) = 100$

$a - 1 = 25$

$\Rightarrow a = 26$

10 **At certain temperature (T) for the gas phase reaction** $2H_2O(g)+2Cl_2(g) \rightleftharpoons 4HCl(g)+O_2(g)$ $K_p = 12\times10^8$ atm **If Cl_2, HCl & O_2 are mixed in such a manner that the partial pressure of each is 2 atm and the mixture is brough into contact with excess of liquid water. What would be approximate partial pressure of Cl_2 when equilibrium is attained at tmeperature (T) ?**
[Given : Vapour pressure of water is 380 mm Hg at temperature (T)]

Correct Options:

(C) 3.6×10^{-3} atm

Solution:

Given : -
$K_p = 12 \times 10^8$ atm for reaction
$2H_2O(g) + 2Cl_2(g) \rightleftharpoons 4HCl(g) + O_2(g)$
2atm 2atm 2atm

$\frac{380}{760} = \frac{1}{2}$ 2–2y 2 + 4x 2 + x

$K_p = 12 \times 10^8$; $K_p >> 1$

$\Rightarrow x \approx 1$

$\Rightarrow 12\times10^8 = \frac{(3)\times(6)^4}{y^2\times(1/2)^2}$

$\Rightarrow \frac{12\times10^8}{3\times36\times36\times4} = \frac{1}{y^2}$

$\Rightarrow y = \frac{36\times2}{2\times10^4} = 2\times18\times10^{-4}$

$y = 36\times10^{-4}$ atm

$y = 3.6\times10^{-3}$ atm

11 **The equilibrium constant for the reaction** $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ **K_c = 3 at 500 K. In a 2 litre vessel 60 gm of water gas [equimolar mixture of CO(g) and H_2(g)] and 90 gm of steam is initially taken.**
What is the equilibrium concentration of H_2(g) at equilibrium (mole/L) ?

Correct Options:

(A) 1.75

Solution:

Given :- Reaction

$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2 \quad K_C = 3$

	(g)	(g)	(g)	(g)
	2 mole	5 mole		2 mole
At eq.	2–x	5–x	x	2 + x

$$K_C = \frac{[CO_2][H_2]}{[H_2O][CO_2]}$$

$$3 = \frac{(x).(2+x)}{(5-x)(2-x)}$$

$$3[10 - 7x + x^2] = 2x + x^2$$

$$2x^2 - 23x + 30 = 0$$

$$\left(x - \frac{3}{2}\right)(x - 10) = 0$$

$$x = \frac{3}{2} \qquad x \neq 10$$

$$\text{conc. of } H_2 = \left(2 + \frac{3}{2}\right)/2$$

$$\Rightarrow \frac{2+1.5}{2} \Rightarrow \frac{3.5}{2}$$

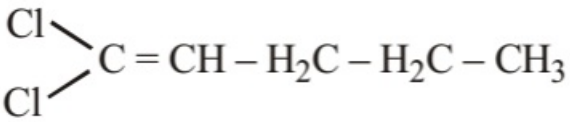
Now, $\Rightarrow 1.75$

12 Geometrical isomerism is not shown by -

Correct Options:

(A) 1, 1– dichloro–1–pentene

Solution:

(A). 

Similar group are attached to double bonded C.

13 Total no. of structural isomers possible for compound with molecular formula C_7H_{16}

Correct Options:

(A) 9

Solution:

C_7H_6

Total str Isomer = 9

14 Molecular formula $C_5H_{10}O$ can have -

Correct Options:

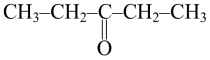
(B) 5-Aldehyde, 3-Ketone

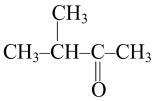
Solution:

$C_5H_{10}O$

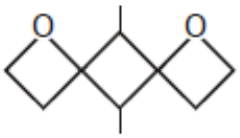
5 aldehyde 3 Ketones

CH_3–CH_2–CH_2–CH_2–CHO





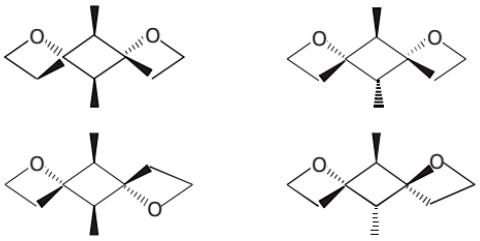
15 **Total number of geometrical isomer of given compound will be**



Correct Options:

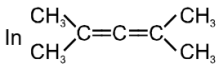
(B) 4

Solution:



n = 2, $2^2 = 4$

16



How many carbon atoms are linearly arranged ?

Correct Options:

(C) 3

Solution:

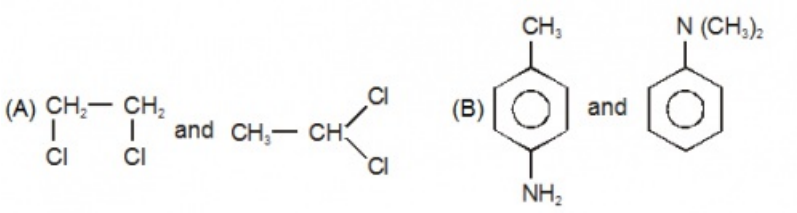
CONCEPTUAL

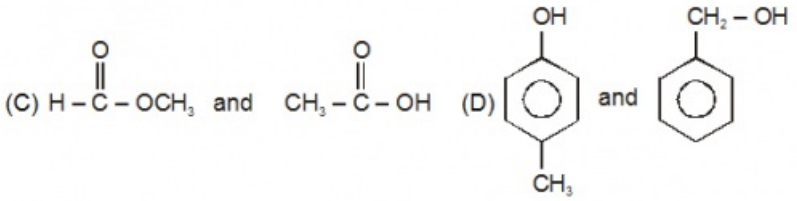
17 **Identify incorrect match of structural isomers**

Correct Options:

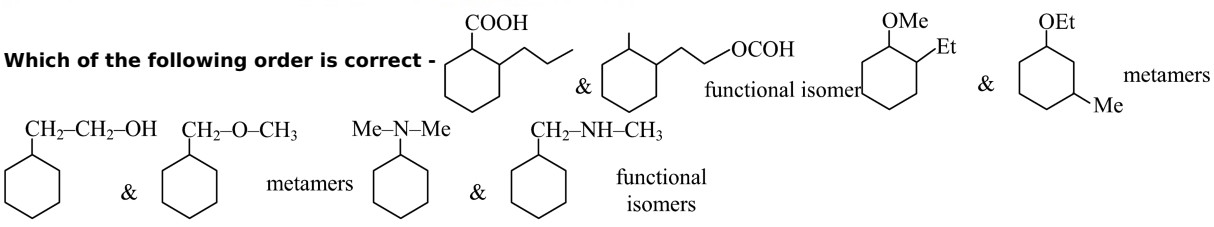
(B)
p-toluidine and N, N-dimethyl aniline

Solution:





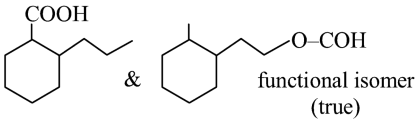
18 **Which of the following order is correct -**



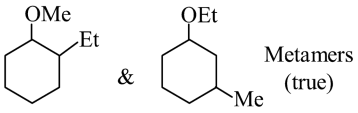
Correct Options:

(C) TTFT

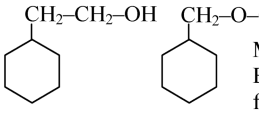
Solution:



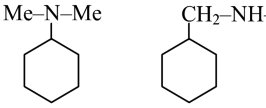
functional isomer
(true)



Metamers
(true)



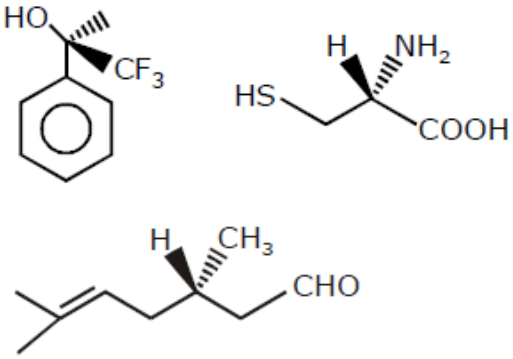
Metamers false
Because these are
functional group
isomer



Functional are
isomer (true)

19

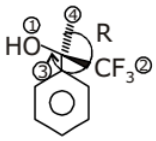
The R/S configuration of these compounds are respectively.

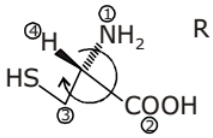


Correct Options:

(C) R, S, S

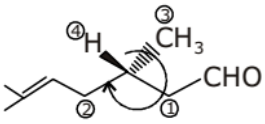
Solution:





R → S

Reverse because (4) group at
wedge.

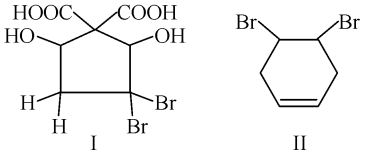


R → S

(C) R,S,S

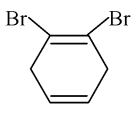
20

Which will show geometrical isomerism

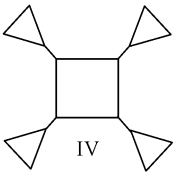


I

II



III


IV

Correct Options:

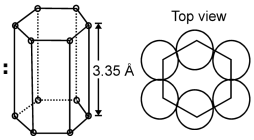
(D) I, II, IV

Solution:

I, II, IV fulfill condition of geometric isomerism

21

Regarding graphite the following informations are available :



The density of graphite = 2.25 gm / cm^3. What is C–C bond distance in graphite ?

Correct Options:

(D) 1.426 Å

Solution:

Let C – C bond distance in graphite is d Aº

∴Surface area = $6 \times \frac{\sqrt{3}}{4} \times d^2$

$= 6 \times \frac{\sqrt{3}}{4} \times d^2 \times 10\text{–}16\ cm^2$

∴vol. of the unit cell

$= 6 \times \frac{\sqrt{3}}{4} \times d^2 \times 10^{-16} \times 3.35 \times 10^{-8}\ cm^3$

∴mass of the unit cell

$= 6 \times \frac{\sqrt{3}}{4} \times 3.35 \times d^2 \times 2.25 \times 10^{-24}$ gm.

$\therefore 6 \times \frac{\sqrt{3}}{4} \times 3.35 \times 2.25 \times 10^{-24} \times d^2$

$= 12 \times \frac{10}{6} \times 10^{-24} \times 2$

$\therefore d^2 = \frac{10}{3} \times 4\ \frac{1 \times 2}{\sqrt{3} \times 3.35 \times 2.25} = 2.04265$

ord = 1.429 Aº

22 Regarding symmetry of simple cubical lattice which of the following is/are correct ?

Correct Options:

(D) All of the given are correct

Solution:

There are three rotation axes are present in a cubic crystal. These are — (i) Tetrad axes (3) (ii) Triad axes (4) (iii) Diad axes (6)

Tetrad axes:- There are three such axes each passing through the centre of the two opposite faces.

Triad axes :- There are four such axes, each passing through the opposite cross corners of the cube.

Diad axes :- There are six such axes, each passing through the centre of two opposite edges of two opposite faces. There are two types of planes in a cubic crystal.

(i)Parallel plane – There are three such planes, each passing through the middle of the two opposite faces and being parallel to the side of the cube.

(ii)Diagonal planes- There are six such planes, each passing through the diagonals of the two opposite faces. There is one centre of symmetry.

23 Select the incorrect statement among the following.

Correct Options:

(C)
The void fraction in a BCC unit cell
is 0.68.

Solution:

In CsCl structure, $r_c + r_a = \frac{\sqrt{3}a}{2}$

In NaCl structure, rc + ra = $\frac{a}{2}$

Packing fraction of a BCC unit cell is 0.68, so the void fraction would be 1 − 0.68 = 0.32

In FCC unit cell, packing percentage = 74%

∴Void percentage = 100 − 74 = 26%

24 If an element (at. wt. = 50) crystallizes in fcc lattice, with a = 0.50 nm. What is the density of unit cell if it contains 0.25% schottky defects (use $N_A = 6 \times 10^{23}$)

Correct Options:

(B) 2.66 g/cc

Solution:

$\rho theoretical = \frac{N \times mol.wt}{a^3 \times N_a} = \frac{4 \times 50}{(0.50 \times 10^{-7})^3 cm^3 \times 6 \times 10^{23}}$

$= \frac{200}{0.75 \times 10^{-21+23}} = 2.66\ g/cm^3$

$\%\ missing = \frac{\rho_{theo} - \rho_{exp}}{\rho_{exp}} \times 100$

$0.25 = \frac{2.66 - \rho_{exp}}{2.66} \times 100$

0.00665 = 2.66 – ρexp

ρexp = 2.66665 g/cm3

25 How many unit cells are present in a cube-shaped idela crystal of NaCl of mass 1.00 g ? [Atomic masses Na = 23, Cl = 35.5]

Correct Options:

(C) 2.57×10^{21} unit cells

Solution:

Mass per unit cell of NaCl

$= 4 \times 58.5 = 234u = \frac{234 \times 1}{6.02 \times 10^{23}} gm$

So, No. of unit cell in 1.0gm $= \frac{6.02 \times 10^{23}}{234} = 2.57 \times 10^{21}$