



**JEE  
MAIN  
July  
2021**

**CHEMISTRY**  
22<sup>nd</sup> July 2021 [SHIFT – 2]  
QUESTION WITH SOLUTION

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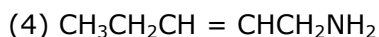
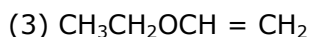
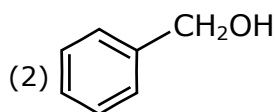
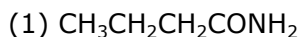
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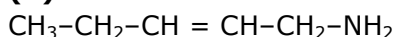


### SECTION -A

1. Which one of the following compounds does not exhibit resonance ?



**Sol. (4)**



This is non conjugated compound.

2. Match List-I with List-II :

#### List - I

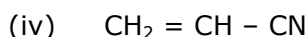
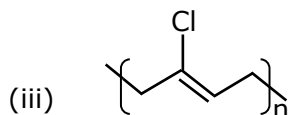
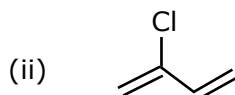
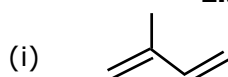
(a) Chloroprene

(b) Neoprene

(c) Acrylonitrile

(d) Isoprene

#### List - II



Choose the correct answer from the options given below :

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

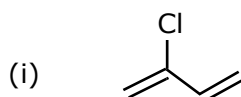
(2) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

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

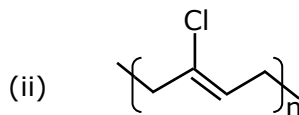
(4) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

**Sol. (2)**

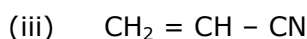
(a) Chloroprene



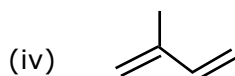
(b) Neoprene



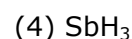
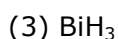
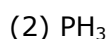
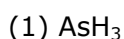
(c) Acrylonitrile



(d) Isoprene



3. Which one of the following group-15 hydride is the strongest reducing agent ?



**Sol. (3)**

Among 15<sup>th</sup> group hydrides,  $\text{BiH}_3$  is strongest reducing agent.

4. Which one of the following 0.06 M aqueous solutions has lowest freezing point ?

- (1)  $C_6H_{12}O_6$
- (2)  $K_2SO_4$
- (3) KI
- (4)  $Al_2(SO_4)_3$

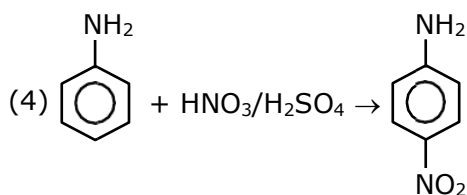
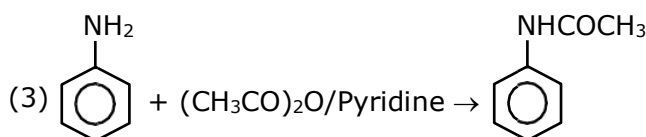
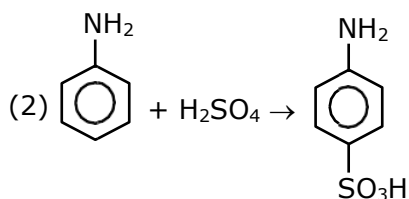
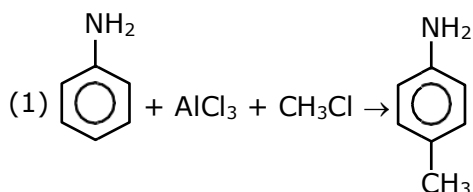
Sol. (4)

$$\Delta T_f = i k_f \times m$$

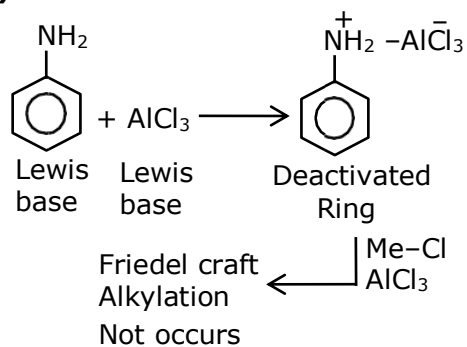
$$\Delta T_f \propto i \text{ but F.P.} \propto 1/i$$

Therefore Ans. 4

5. Which one of the following reactions does not occur ?



Sol. (1)



- (1) Aniline is lewis base give acid base reaction with  $AlCl_3$  and form Anilinium ion
- (2) Anilinium ion has strongest deactivated ring so further Friedel craft Alkylation not occurs.

6. Match List-I with List-II :

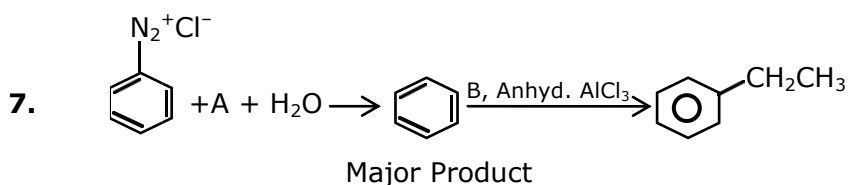
<b>List-I</b> (Species)		<b>List-II</b> (Hybrid Orbitals)	
(a)	SF <sub>4</sub>	(i)	sp <sup>3</sup> d <sup>2</sup>
(b)	IF <sub>5</sub>	(ii)	d <sup>2</sup> sp <sup>3</sup>
(c)	NO <sub>2</sub> <sup>+</sup>	(iii)	sp <sup>3</sup> d
(d)	NH <sub>4</sub> <sup>+</sup>	(iv)	sp <sup>3</sup>
		(v)	sp

Choose the correct answer form the options given below :

- (1) (a)-(i), (b)-(ii), (c)-(v) and (d)-(iii)
- (2) (a)-(ii), (b)-(i), (c)-(iv) and (d)-(v)
- (3) (a)-(iv), (b)-(iii), (c)-(ii) and (d)-(v)
- (4) (a)-(iii), (b)-(i), (c)-(v) and (d)-(iv)

**Sol. (4)**

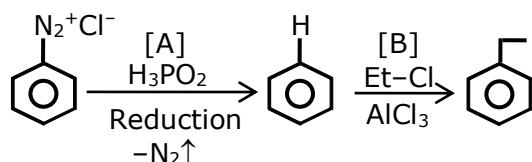
- (a) SF<sub>4</sub> – sp<sup>3</sup>d hybridisation
- (b) IF<sub>5</sub> – sp<sup>3</sup>d<sup>2</sup> hybridisation
- (c) NO<sub>2</sub><sup>+</sup> – sp hybridisation
- (d) NH<sub>4</sub><sup>+</sup> – sp<sup>3</sup> hybridisation



In the chemical reaction given above A and B respectively are :

- (1) CH<sub>3</sub>CH<sub>2</sub>OH and H<sub>3</sub>PO<sub>2</sub>
- (2) H<sub>3</sub>PO<sub>2</sub> and CH<sub>3</sub>CH<sub>2</sub>Cl
- (3) H<sub>3</sub>PO<sub>2</sub> and CH<sub>3</sub>CH<sub>2</sub>OH
- (4) CH<sub>3</sub>CH<sub>2</sub>Cl and H<sub>3</sub>PO<sub>2</sub>

**Sol. (2)**



8. The set having ions which are coloured and paramagnetic both is :

- (1) Sc<sup>3+</sup>, V<sup>5+</sup>, Ti<sup>4+</sup>
- (2) Cu<sup>2+</sup>, Cr<sup>3+</sup>, Sc<sup>3+</sup>
- (3) Ni<sup>2+</sup>, Mn<sup>7+</sup>, Hg<sup>2+</sup>
- (4) Cu<sup>+</sup>, Zn<sup>2+</sup>, Mn<sup>4+</sup>

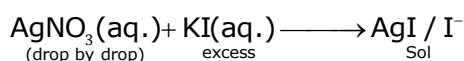
**Sol. (2)**

$\left. \begin{array}{l} \text{Cu}^{2+} : [\text{Ar}]3d^9 4s^0 \\ \text{Cr}^{3+} : [\text{Ar}]3d^3 4s^0 \\ \text{Sc}^{3+} : [\text{Ar}]3d^1 4s^1 \end{array} \right\} \begin{array}{l} \text{All are coloured and} \\ \text{paramagnetic due to} \\ \text{presence of unpaired } e^- \end{array}$

9. When silver nitrate solution is added to potassium iodide solution then the sol produced is :

- (1)  $\text{AgNO}_3/\text{NO}_3^-$
- (2)  $\text{AgI}/\text{I}^-$
- (3)  $\text{KI}/\text{NO}_3^-$
- (4)  $\text{AgI}/\text{Ag}^+$

Sol. (2)



10. Sulphide ion is soft base and its ores are common for metals.

- (a) Pb
- (b) Al
- (c) Ag
- (d) Mg

Choose the correct answer from the options given below :

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

Sol. (1)

Pb and Ag commonly exist in the form of sulphide ore like PbS (galena) and  $\text{Ag}_2\text{S}$  (Argentite). 'Al' is mainly found in the form of oxide ore whereas 'Mg' is found in the form of halide ore.

11. The water having more dissolved  $\text{O}_2$  is :

- (1) boiling water
- (2) water at  $80^\circ\text{C}$
- (3) polluted water
- (4) water at  $4^\circ\text{C}$

Sol. (4)

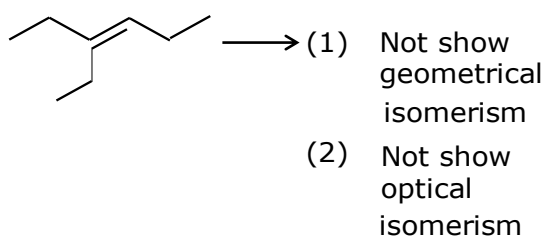
On heating concentration of  $\text{O}_2$  in water decreases. So boiling water and water at  $80^\circ\text{C}$  having less  $\text{O}_2$  concentration. Polluted water also having less  $\text{O}_2$  concentration. So water at  $4^\circ\text{C}$  having maximum  $\text{O}_2$  concentration.

12. Which one of the following molecules does not show stereo isomerism ?

- (1) 3, 4-dimethylhex-3-ene
- (2) 4-Methylhex-1-ene
- (3) 3-Methylhex-1-ene
- (4) 3-Ethylhex-3-ene

Sol. (4)

3-Ethylhex-3-ene will not show stereo isomerism its diagram is.



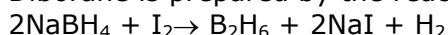
- 13.** Given below are the statements about diborane.  
 (a) Diborane is prepared by the oxidation of  $\text{NaBH}_4$  with  $\text{I}_2$ .  
 (b) Each boron atom is in  $\text{sp}^2$  hybridized state.  
 (c) Diborane has one bridged 3 centre-2-electron bond.  
 (d) Diborane is a planar molecule.

The option with correct statement(s) is :

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

**Sol. (3)**

Diborane is prepared by the reaction of  $\text{NaBH}_4$  with  $\text{I}_2$ .



In diborane, 'B' is  $\text{sp}^3$  hybrid, it is Non-planar and two  $3\text{c}-2\text{e}^-$  bonds are present.

- 14.** Thiamine and pyridoxine are also known respectively as :

- (1) Vitamin  $\text{B}_2$  and Vitamin E  
 (2) Vitamin  $\text{B}_1$  and Vitamin  $\text{B}_6$   
 (3) Vitamin  $\text{B}_6$  and Vitamin  $\text{B}_2$   
 (4) Vitamin E and Vitamin  $\text{B}_2$

**Sol. (2)**

Vitamine- $\text{B}_1$  is also known as Thiamine while vitamin B-6 is known as Pyridoxine

- 15.** Match List-I with List-II :

<b>List-I</b> (Elements)	<b>List-II</b> (Properties)
(a) Ba	(i) Organic solvent soluble compounds
(b) Ca	(ii) Outer electronic configuration $6s^2$
(c) Li	(iii) Oxalate insoluble in water
(d) Na	(iv) Formation of very strong monoacidic base

Choose the correct answer form the options given below :

- (1) (a)-(iv), (b)-(i), (c)-(ii) and (d)-(iii)  
 (2) (a)-(i), (b)-(iv), (c)-(ii) and (d)-(iii)  
 (3) (a)-(iii), (b)-(ii), (c)-(iv) and (d)-(i)  
 (4) (a)-(ii), (b)-(iii), (c)-(i) and (d)-(iv)

**Sol. (4)**

- (a) 'Ba' having outer electronic configuration  $6s^2$ .  
 (b)  $\text{CaC}_2\text{O}_4$  is water insoluble  
 (c) 'Li' is soluble in organic solvents  
 (d)  $\text{NaOH}$  is strong Monoacidic base among given.

- 16.** Which one of the following statements for D.I. Mendeleeff, is incorrect ?

- (1) At the time, he proposed Periodic Table of elements structure of atom was known.  
 (2) Element with atomic number 101 is named after him.  
 (3) He invented accurate barometer.  
 (4) He authored the textbook – Principles of Chemistry.

**Sol. (2)**

At the time, he proposed the periodic table but structure of atom was unknown.

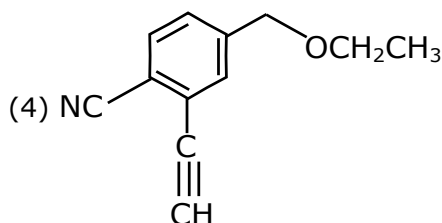
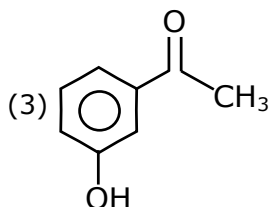
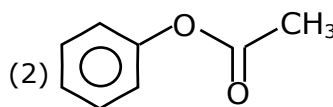
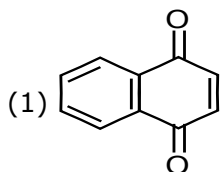
- 17.** Isotope(s) of hydrogen which emits low energy  $\beta^-$  particle with  $t_{1/2}$  value  $> 12$  years is/are :

- (1) Deuterium  
 (2) Deuterium and Tritium  
 (3) Protium  
 (4) Tritium

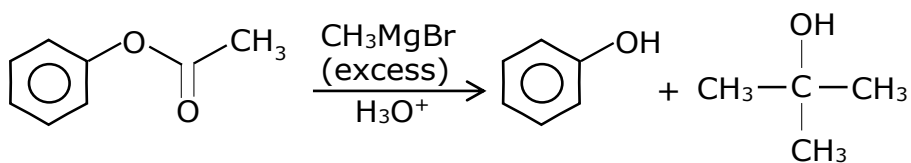
**Sol. (4)**

In case of hydrogen tritium is a radioactive Element.

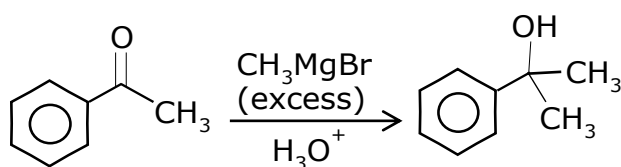
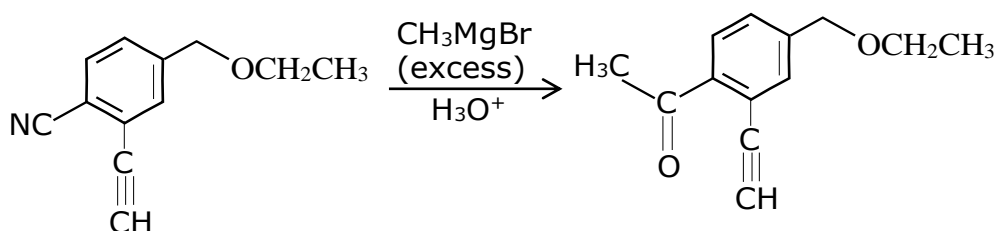
18. Which one of the following compounds will provide a tertiary alcohol on reaction with excess of  $\text{CH}_3\text{MgBr}$  followed by hydrolysis ?



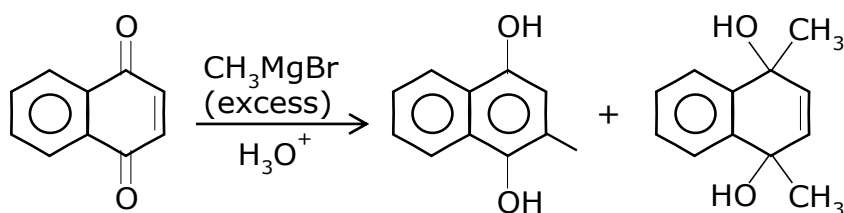
Sol. (2)



Tertiary alcohol



Phenolic -OH group and tertiary Alcohol is present thus two functional groups are present in the product

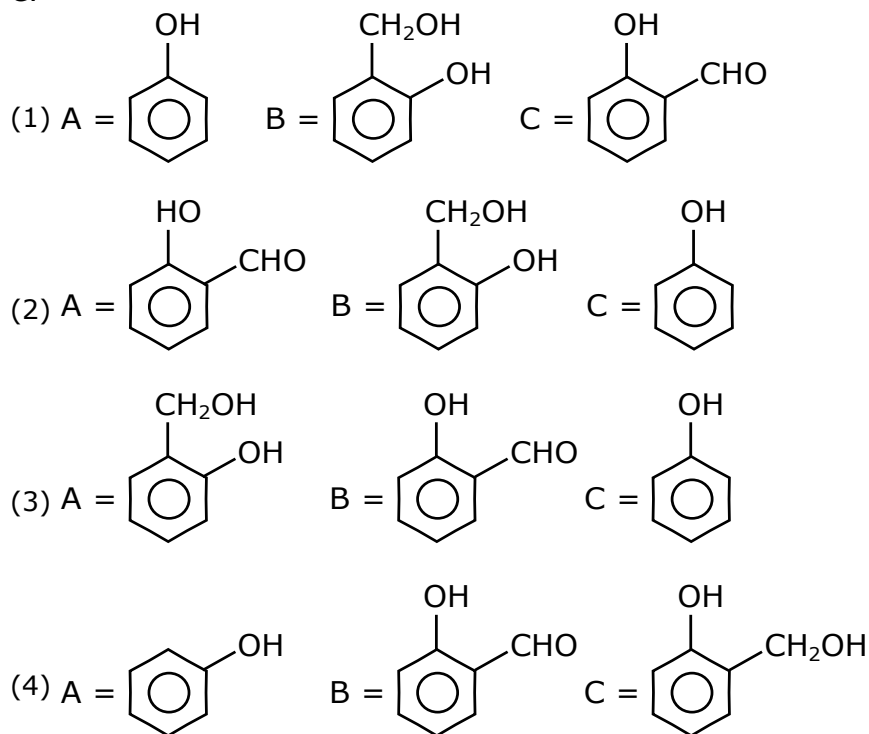


Two 3° alcohol

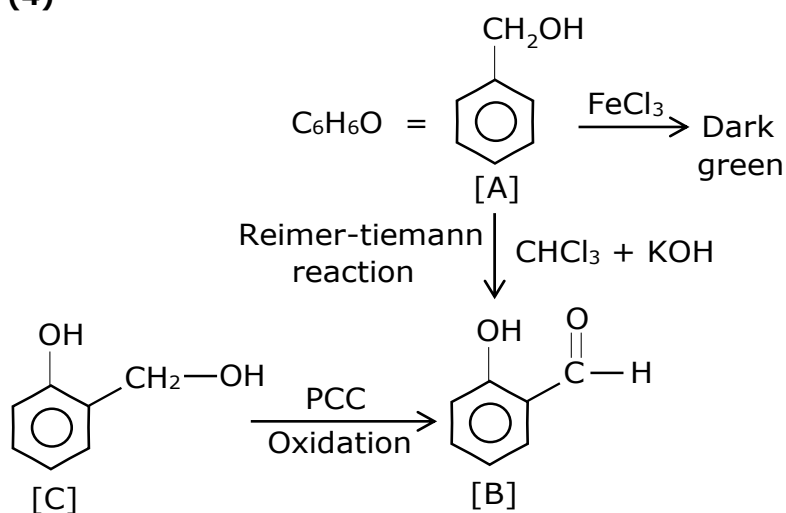
Compound (1), (2), (3) can also give 3°-alcohol but most appropriate answer will be (2).



19. An organic compound A ( $C_6H_6O$ ) gives dark green colouration with ferric chloride. On treatment with  $CHCl_3$  and  $KOH$ , followed by acidification gives compound B. Compound B can also be obtained from compound C on reaction with pyridinium chlorochromate (PCC). Identify A, B and C.



Sol. (4)



20. Which purification technique is used for high boiling organic liquid compound (decomposes near its boiling point) ?
- (1) Steam distillation (2) Simple distillation  
 (3) Fractional distillation (4) Reduced pressure distillation

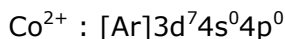
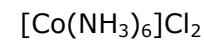
Sol. (4)

Reduced pressure distillation used for the purification of high boiling organic liquids which decomposes at or below their boiling point.

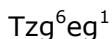
### SECTION –B

1. The total number of unpaired electrons present in  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$  and  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$  is \_\_\_\_\_.

**Sol. (1)**



For this complex  $\Delta_0 < \text{P.E.}$ , so pairing of electron does not take place.



Total one unpaired electrons are present.

2. Methylation of 10 g of benzene gave 9.2 g of toluene. Calculate the percentage yield of toluene \_\_\_\_\_ . (Nearest integer)

**Sol. (78)**

$$\text{Moles of } \text{C}_6\text{H}_6 = 10/78$$

$$\text{moles of toluene} = 10/78$$

$$w_t \text{ of toluene should be} = 10/78 \times 92$$

$$\% \text{ yield} = \frac{9.2}{\frac{10}{78} \times 92} \times 100 = 78\%$$

3.  $\text{N}_2\text{O}_{5(g)} \rightarrow 2\text{NO}_{2(g)} + \frac{1}{2}\text{O}_{2(g)}$

In the above first order reaction the initial concentration of  $\text{N}_2\text{O}_5$  is  $2.40 \times 10^{-2} \text{ mol L}^{-1}$  at 318 K. The concentration of  $\text{N}_2\text{O}_5$  after 1 hour was  $1.60 \times 10^{-2} \text{ mol L}^{-1}$ , The rate constant of the reaction at 318 K is \_\_\_\_\_  $\times 10^{-3} \text{ min}^{-1}$ . (Nearest integer)

[Given:  $\log 3 = 0.477$ ,  $\log 5 = 0.699$ ]

**Sol. (7)**

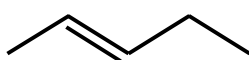
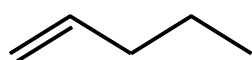
$$k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$$

$$k = \frac{2.303}{t} \log \frac{[\text{N}_2\text{O}_5]}{[\text{N}_2\text{O}_5]}$$

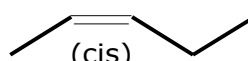
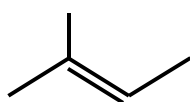
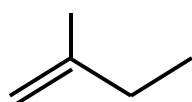
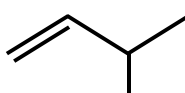
$$= \frac{2.303}{60} \log \frac{2.4}{1.6} = 6.76 \times 10^{-3} \text{ min}^{-1} \approx 7 \times 10^{-3} \text{ min}^{-1}$$

4. The number of acyclic structural isomers (including geometrical isomers) for pentene are \_\_\_\_\_.

**Sol. (6)**



(trans)



(cis)

5. A copper complex crystallising in a CCP lattice with a cell edge of 0.4518 nm has been revealed by employing X-ray diffraction studies. The density of a copper complex is found to be 7.62 g cm<sup>-3</sup>. The molar mass of copper complex is \_\_\_\_\_ g mol<sup>-1</sup>. (Nearest integer)

[Given :  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ ]

**Sol. (106)**

$$a = 0.4518 \text{ nm}, d = 7.62 \text{ gm/cm}^3$$

$$a = 0.4518 \text{ nm}, d = 7.62 \text{ gm/cm}^3$$

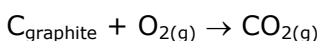
$$d = \frac{z \times M / N_A}{a^3} \quad z = 4$$

$$d \left( \frac{\text{gm}}{\text{cc}} \right) = \frac{4 \times \frac{M}{N_A}}{(a \text{ cm})^3}$$

$$7.62 = \frac{4 \times M / 6.022 \times 10^{23}}{(0.4518 \times 10^{-7} \text{ cm})^3} \Rightarrow M = 105.8 \text{ g/mol}$$

6. If the standard molar enthalpy change for combustion of graphite powder is  $-2.48 \times 10^2 \text{ kJ mol}^{-1}$ , the amount of heat generated on combustion of 1g of graphite powder is \_\_\_\_\_ kJ. (Nearest integer)

**Sol. (21)**



$$\Delta H = -2.48 \times 10^2$$

$$\text{Heat generated} = \frac{2.4 \times 10^2}{12} \text{ KJ}$$

7. If the concentration of glucose ( $C_6H_{12}O_6$ ) in blood is  $0.72 \text{ g L}^{-1}$ , the molarity of glucose in blood is \_\_\_\_\_  $\times 10^{-3} \text{ M}$ . (Nearest integer)  
(Given : Atomic mass of C = 12, H = 1, O = 16 u)

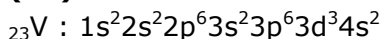
**Sol. (4)**

molarity = moles/volume

$$= \frac{0.72}{180} = 4 \times 10^{-3} = M$$

8. Number of electrons that Vanadium ( $Z = 23$ ) has in p-orbitals is equal to \_\_\_\_\_.

**Sol. (12)**



Number of electrons in p-orbitals is equal to 12.00

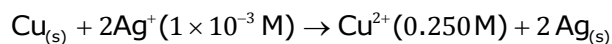
9. Value of  $K_p$  for the equilibrium reaction  $N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$  at 288 K is 47.9. The  $K_c$  for this reaction at same temperature is \_\_\_\_\_. (Nearest integer)  
( $R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$ )

**Sol. (2)**

$$K_p = K_c (RT)^{\Delta n}$$

$$K_c = \frac{K_p}{RT} = \frac{47.9}{0.083 \times 288} = 2$$

**10.** Assume a cell with the following reaction



$$E_{\text{Cell}}^{\ominus} = 2.97 \text{ V}$$

$E_{\text{cell}}$  for the above reaction is \_\_\_\_\_ V. (Nearest integer)

[Given :  $\log 2.5 = 0.3979$ ,  $T = 298 \text{ K}$ ]

**Sol. (3)**

$$\begin{aligned} E &= E^{\ominus} - \frac{0.059}{2} \log \frac{[\text{Cu}^{2+}]}{[\text{Ag}^+]^2} \\ &= 2.97 - \frac{0.059}{2} \log \frac{0.25}{(10^{-3})^2} = 2.81 \text{ V} \end{aligned}$$

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