

# Gaseous State



By  
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- Q4) A Compound contains 28% N and 72% of a metal by weight. Three atoms of metal combine with two atoms of nitrogen. find atomic wt of Metal
- a) 24      b) 20      c) 36      d) 48

Solution :

$$3M + 2N \longrightarrow M_3N_2$$
$$\frac{(3x + 28)g}{100g} M_3N_2 \text{ has metal} = \frac{3x}{3x + 28} = \frac{100 \times 3x}{3x + 28}$$

$$\frac{100 \times 3x}{3x + 28} = 72, \quad x = 24.$$



Q5) When 400g of a 20% solution by weight was cooled, 50g of solute precipitated. What is the Percentage concentration of remaining solution.

- a) 8.75%      b) 10.75%      c) 2.50%      d) 5.25%

Solution: Weight of solution = 400 g

$$\text{Weight of solute} = \frac{20 \times 400}{100} = 80 \text{ g}$$

$$\text{Weight of solute precipitated} = 50 \text{ g}$$

$$\text{Weight of solute remained} = 80 - 50 = 30 \text{ g}$$

in solution

$$\text{Weight of solution remained} = 400 - 50 = 350 \text{ g}$$

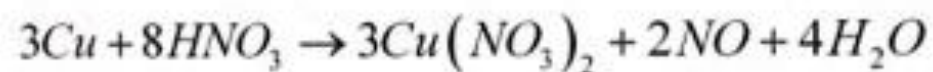
$$\% \text{ by weight} = \frac{30}{350} \times 100 = 8.57 \%$$

9. What volume of  $0.010\text{M NaOH}_{(aq)}$  is required to react completely with  $30\text{g}$  of an aqueous acetic acid solution in which mole fraction of acetic acid is  $0.15$

- (A)  $18.55$  litre      (B)  $43.25$  litre      (C)  $4.25$  litre      (D)  $72.68$  litre

Ans: (A)

12. The equivalent weight of  $\text{HNO}_3$  in the following reaction is .....



(A) 63

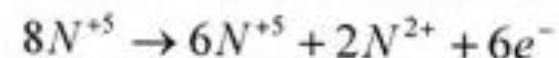
(B) 84

(C) 47.25

(D) 31.5

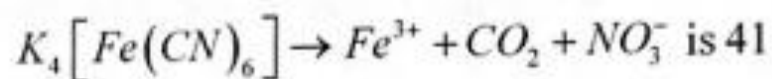
Ans:

(B)

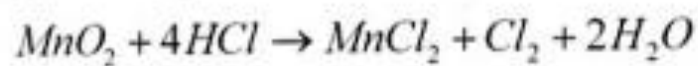


13. Which of the following statements are correct

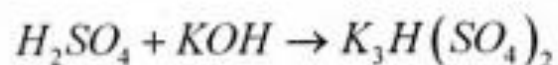
(A) The n factor of  $K_4[Fe(CN)_6]$  in the reaction



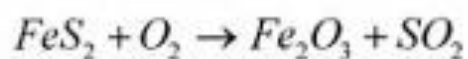
(B) The equivalent weight of HCl in the reaction is 71



(C) The n factor of  $H_2SO_4$  in the reaction is 65.33



(D) The n factor of  $FeS_2$  is 11 in the reaction







**PROBLEM 51** A hydrogen-like atom (atomic number  $Z$ ) is in a higher excited state of quantum number  $n$ . This excited atom can make a transition to the first excited state by successively emitting two photons of energies  $10.20 \text{ eV}$  and  $17.00 \text{ eV}$  respectively. Alternatively, the atom from the same excited state can make a transition to the second excited state by successively emitting two photons of energy  $4.25 \text{ eV}$  and  $5.95 \text{ eV}$  respectively. Determine the values of  $n$  and  $Z$ .



**PROBLEM 53** What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition  $n = 4$  to  $n = 2$  of  $\text{He}^+$  spectrum? **(IIT 1993)**

**Solution** For  $\text{He}^+$ ,

$$\frac{1}{\lambda} = R_H \cdot Z^2 \left[ \frac{1}{2^2} - \frac{1}{4^2} \right]$$

For H,

$$\frac{1}{\lambda} = R_H \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

Since  $\lambda$  is same

$$\therefore Z^2 \left[ \frac{1}{2^2} - \frac{1}{4^2} \right] = \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$\therefore Z = 2$$

$$\therefore \left[ \frac{1}{1^2} - \frac{1}{2^2} \right] = \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$\therefore n_1 = 1 \text{ and } n_2 = 2$$

**PROBLEM 84** Energy required to stop the ejection of electrons from Cu plate is 0.24 eV. Calculate the work function when radiations of  $\lambda = 253.7 \text{ nm}$  strikes the plate.

**Solution** Energy of photon = work function +  $1/2 mu^2$

$$\text{Energy of photon} = \text{work function} + eV_0 \quad \dots (1)$$

where  $e$  is electronic charge and  $V_0$  is stopping potential and  $eV_0$  is equal to energy required to stop the ejection of electron.

$$\begin{aligned} \therefore E_{\text{photon}} &= \frac{hc}{\lambda} = \frac{6.625 \times 10^{-34} \times 3.0 \times 10^8}{253.7 \times 10^{-9}} = 7.834 \times 10^{-19} \text{ J} \\ &= \frac{7.834 \times 10^{-19}}{1.602 \times 10^{-19}} \text{ eV} = 4.89 \text{ eV} \end{aligned}$$

$\therefore$  By Eq. (1)  $4.89 = \text{work function} + 0.24$

$$\text{Work function} = 4.65 \text{ eV}$$

Q) In hydrogen atom an orbit has a diameter of about  $16.92 \text{ \AA}$  what is the maximum no of electrons that can be accommodated

- a) 8      b) 32      c) 50      d) 72



$$D = 16.92$$

$$r = 8.46 \text{ \AA}$$

$$r = \frac{0.53 n^2}{Z}$$

$$8.46 = 0.13 \times n^2$$

$$n = 4$$

$$2n^2 = 32$$

Q The KE of an electron in the second bohrs orbit of a hydrogen atom is .

[  $a_0$  is Bohrs radius ]

a)  $\frac{h^2}{4\pi^2 m a_0^2}$

b)  $\frac{h^2}{16\pi^2 m a_0^2}$

c)  $\frac{h^2}{32\pi^2 m a_0^2}$

d)  $\frac{h^2}{64\pi^2 m a_0^2}$



Q) In a collection of H atoms, when electrons make a transition from 5th excited state to 2nd excited state then maximum number of different types of photons observed are

- A) 3                      B) 4                      C) 6                      D) 15

Q) The reaction  $2C + O_2 \rightarrow 2CO$  is carried out by taking 24g C and 96g  $O_2$  find out.

- a) LR    b) wt of left reactant.
- c) wt of CO formed
- d) How many gm of other reactant should be taken so that nothing is left at the end of reaction.



Solution



$$\frac{24}{12} \quad \frac{96}{32}$$

$$2/2 \quad 3/1$$

LR ~~2~~ (1) 3

0 2

2

a)  $4r = C$

b) 2 mole of  $O_2 = 64g$

c) 2 mole of  $CO = 56g$

d) To use  $O_2$

completely 6 mole of Carbon or 72g Carbon is needed.

~~6~~ ←

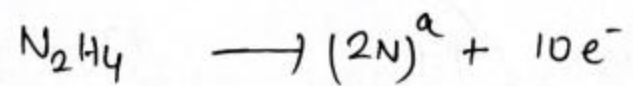
$2 \rightarrow 1$   
 $6 \rightarrow 6/2 = 3$

Q) 2.5 mole of  $N_2H_4$  loses 25 moles of  $e^-$  to form a compound Y. Assuming that all the nitrogen appears in the new compound what will be the OS of nitrogen in Y

a) +3      b) +5      c) -3      d) +1



Soluhon



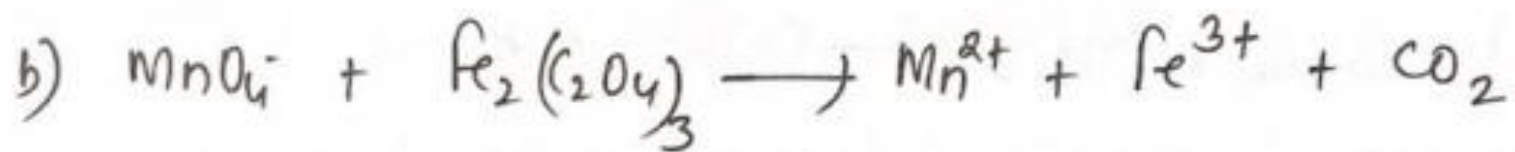
-4

$$-4 = 2a - 10, \quad 2a = +6$$

$$a = +3$$



1 mole  $\text{MnO}_4^-$  reacts with  $x$  mole of  $\text{FeC}_2\text{O}_4$

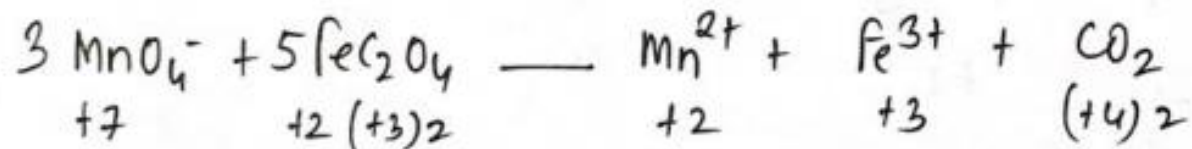


1 mole  $\text{MnO}_4^-$  reacts with  $y$  mole of  $\text{Fe}_2(\text{C}_2\text{O}_4)_3$

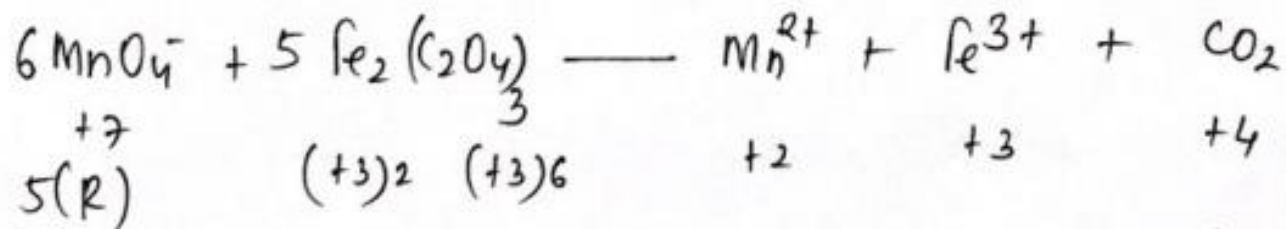
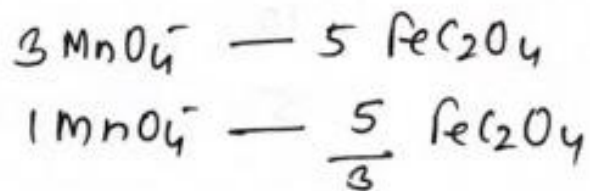
find out the ratio of  $\frac{x}{y}$



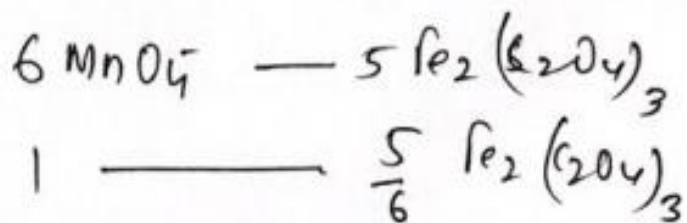
Soluhon :



$$x = \frac{5}{3}$$



$$y = \frac{5}{6}$$



$$\frac{x}{y} = \frac{2}{1}$$

Q1) A Metal weighing 0.43 g was dissolved in 50 ml / N  $H_2SO_4$ . The unreacted  $H_2SO_4$  required 14.2 ml / N NaOH for neutralisation. Calculate EW of Metal is

Ans 12.

**Q.4** If the radius of first Bohr's orbit is  $a$ , then a de-Borglie wavelength of electron in 3rd orbit is

(A)  $6\pi a$

(B)  $3\pi a$

(C)  $2\pi a$

(D)  $2a$

Q) A cylinder contains Nitrogen gas and small amount of liquid water. at  $25^{\circ}\text{C}$  The  $P_T$  inside cylinder is  $600\text{ mm Hg}$  ( $a_{\text{q}}T_{\text{water}} = 23.8\text{ mm}$  at  $25^{\circ}\text{C}$ )  
The piston in cylinder is pushed downwards to reduce volume to half of its initial volume at constant Temp. Calculate the pressure at this condition.

$$P_T (\text{moist gas}) = \underline{P_{N_2}} + \frac{P_{H_2O}}{23.8} = \underline{600}$$

$$\underline{P_{N_2}} = 576.2 \quad \checkmark$$

Apply  $P_1 V_1 = P_2 V_2$

$$P_2 = \underline{1152.4} \quad \checkmark$$

$$P_T = 23.8 + 1152.4 = 1176.2 \quad \checkmark$$



A gas cylinder containing cooking gas can withstand a pressure of 14.9 atmosphere. The pressure gauge of the cylinder indicates 12 atmosphere at  $27^{\circ}\text{C}$ . Due to a sudden fire in the building the temperature starts rising. At what temperature will the cylinder explode ?

- (A) 273 K       (B)  $99.5^{\circ}\text{C}$       (C)  $273^{\circ}\text{C}$       (D) None of These

A balloon blown up with 1 mole of gas has a volume of 480 mL at  $5^{\circ}\text{C}$ . the balloon is filled to  $(7/8)$ th of its maximum capacity the minimum temperature at which it will burst.

(A)  $55^{\circ}\text{C}$

(B)  $100^{\circ}\text{C}$

(C)  $44.67^{\circ}\text{C}$

(D)  $34.67^{\circ}\text{C}$

*X ml of  $H_2$  gas effuses through a hole in a container in 5 seconds. The time taken for the effusion of the same volume of the gas specified below under identical conditions is :*

*(A) 10 seconds : He*

*(B) 20 seconds :  $O_2$*

*(C) 25 seconds : CO*

*(D) 35 seconds :  $CO_2$*

**Solution :** (B)

$$\frac{r_{\text{H}_2}}{r_{\text{He}}} = \sqrt{\frac{4}{2}} = \sqrt{2} \Rightarrow \therefore \text{(A) is incorrect} \quad \frac{r_{\text{H}_2}}{r_{\text{O}_2}} = \sqrt{\frac{32}{2}} = 4$$

$$\text{(B) is correct} \quad \frac{r_{\text{H}_2}}{r_{\text{N}_2}} = \sqrt{\frac{28}{2}} = \sqrt{14} \quad \text{(C) is incorrect} \quad \frac{r_{\text{H}_2}}{r_{\text{CO}_2}} = \sqrt{\frac{2}{44}} = \sqrt{\frac{1}{22}} \quad \text{(D) is incorrect}$$

In a gaseous mixture at  $20^{\circ}\text{C}$ , the total pressure = 775 torr. If the sum of the partial pressures of  $\text{H}_2$  and  $\text{CO}_2$  is 350 torr and the partial volume of hydrogen 19.4%, what is the partial pressure of  $\text{CO}_2$

(A) 225 torr

(B) 300 torr

(C) 275 torr

(D) 200 torr

$O_2$  and He are taken in equal weights in a vessel. The pressure exerted by Helium in the mixture is

(A)  $1/8$  th of total pressure

(B)  $1/9$ th of total pressure

(C)  $2/9$  th of total pressure

(D)  $8/9$ th of total pressure

Equal volumes of two jars contain  $\text{HCl}$ ,  $\text{NH}_3$  gases respectively at constant temperature and pressure  $P$ . When one of the jars is inverted over another jar so that they mix up, the pressure in either of the jars is

(A) 1 atm

(B) Equal to  $P$

(C) Becomes Zero

(D)  $P+P = 2P$

2 grams of Helium diffuses from a porous plate in 4min. How many grams of  $\text{CH}_4$  would diffuse through the same plate in same time under similar conditions?

(A) 4g

(B) 16g

(C) 8g

(D) 2g