

## Q1 2021 (27 Aug Shift 2)

When 5.1 g of solid  $\text{NH}_4\text{HS}$  is introduced into a two litre evacuated flask at  $27^\circ\text{C}$ , 20% of the solid decomposes into gaseous ammonia and hydrogen sulphide. The  $K_p$  for the reaction at  $27^\circ\text{C}$  is  $x \times 10^{-2}$ . The value of  $x$  is \_\_\_\_.

(Integer answer)

[ Given  $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$  ]

## Q2 2021 (27 Aug Shift 1)

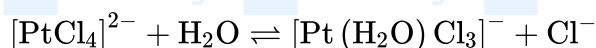
The number of moles of  $\text{NH}_3$ , that must be added to 2 L of 0.80 M  $\text{AgNO}_3$  in order to reduce the concentration of  $\text{Ag}^+$  ions to  $5.0 \times 10^{-8} \text{ M}$  ( $K_{\text{formation}}$  for  $[\text{Ag}(\text{NH}_3)_2]^+ = 1.0 \times 10^8$ ) is \_\_\_\_.

(Nearest integer)

[Assume no volume change on adding  $\text{NH}_3$  ]

## Q3 2021 (26 Aug Shift 2)

The reaction rate for the reaction



was measured as a function of concentrations of different species. It was observed that

$$\frac{-d[\text{PtCl}_4]^{2-}}{dt} = 4.8 \times 10^{-5} \left[ [\text{PtCl}_4]^{2-} \right] - 2.4 \times 10^{-3} \left[ [\text{Pt}(\text{H}_2\text{O})\text{Cl}_3]^- \right] \left[ \text{Cl}^- \right].$$

where square brackets are used to denote molar concentrations. The equilibrium constant  $K_c =$  \_\_\_\_.(Nearest integer)

## Q4 2021 (26 Aug Shift 2)

The equilibrium constant  $K_c$  at 298 K for the reaction  $\text{A} + \text{B} \rightleftharpoons \text{C} + \text{D}$

is 100 . Starting with an equimolar solution with concentrations of A, B, C and D all equal to 1M, the equilibrium concentration of D is \_\_\_\_  $\times 10^{-2}$  M. (Nearest integer)

## Q5 2021 (26 Aug Shift 1)

The  $\text{OH}^-$  concentration in a mixture of 5.0 mL of 0.0504 M  $\text{NH}_4\text{Cl}$  and 2 mL of 0.0210 M  $\text{NH}_3$  solution is  $x \times 10^{-6}$  M. The value of x is \_\_\_\_\_. (Nearest integer)

[ Given  $K_w = 1 \times 10^{-14}$  and  $K_b = 1.8 \times 10^{-5}$  ]

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

# Answer Key

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

**Q1 (6)**

**Q2 (4)**

**Q3 (50)**

**Q4 (182)**

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

**Q5 (3)**

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

// mathongo // mathongo // mathongo // mathongo // mathongo // mathongo

#MathBoleTohMathonGo

Q1 (6)

$$\text{moles of NH}_4\text{HS initially taken} = \frac{5.1 \text{ g}}{51 \text{ g/mol}}$$

$$= 0.1 \text{ mol}$$

$$\text{volume of vessel} = 2\ell$$



$$t = 0 \quad 0.1 \text{ mol}$$

$$t = \infty \quad 0.1(1 - 0.2) \quad 0.1 \times 0.2 \quad 0.1 \times 0.2$$

$\Rightarrow$  partial pressure of each component

$$P = \frac{nRT}{V} = \frac{0.1 \times 0.2 \times 0.082 \times 300}{2}$$

$$= 0.246 \text{ atm}$$

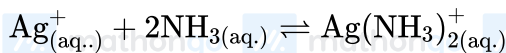
$$\Rightarrow K_P = P_{\text{NH}_3} \times P_{\text{H}_2\text{S}} = (0.246)^2 = 0.060516$$

$$= 6.05 \times 10^{-2}$$

$$\Rightarrow 6$$

Q2 (4)

Let moles added = a



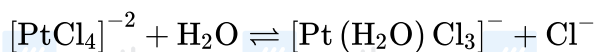
$$t = 0 \quad 0.8 \quad \left(\frac{a}{2}\right)$$

$$t = \infty \quad 5 \times 10^{-8} \quad \left(\frac{a}{2} - 1.6\right) \quad 0.8$$

$$\frac{0.8}{(5 \times 10^{-8}) \left(\frac{a}{2} - 1.6\right)^2} = 10^8$$

$$\Rightarrow \frac{a}{2} - 1.6 = 0.4 \Rightarrow a = 4$$

Q3 (50)

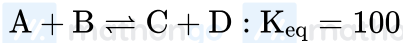


$$\frac{-d[\text{PtCl}_4]^{-2}}{dt} = 4.8 \times 10^{-5} \left[ \text{PtCl}_4^{-2} \right] - 2.4 \times 10^3$$

$$[\text{Pt}(\text{H}_2\text{O})\text{Cl}_3] \text{ [u]}$$

$$\Rightarrow K_{\text{eq}} = \frac{k_f}{k_b} = \frac{4.8 \times 10^{-5}}{2.4 \times 10^{-3}} = 0.02$$

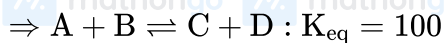
Q4 (182)



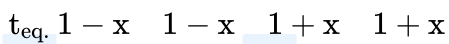
First check direction of reversible reaction.

Since  $Q_c = \frac{[C][D]}{[A][B]} = 1 < K_{eq} \Rightarrow$  reaction will

move in forward direction to attain equilibrium state.



to 1 - x    1 - x    1 + x    1 + x



$$\text{Now : } K_{eq} = 100 = \frac{(1+x)(1+x)}{(1-x)(1-x)}$$

$$\Rightarrow 100 = \left(\frac{1+x}{1-x}\right)^2$$

$$(i) 10 = \left(\frac{1+x}{1-x}\right)$$

$$\Rightarrow 10 - 10x = 1 + x$$

$$\Rightarrow 11x = 9$$

$$\Rightarrow x = \frac{9}{11}$$

$$(ii) -10 = \frac{1+x}{1-x}$$

$$\Rightarrow -10 + 10x = 1 + x$$

$$\Rightarrow -9x = -11$$

$$\Rightarrow x = \frac{11}{9}$$

$\rightarrow$  'x' cannot be more than one, therefore not valid. therefore equation concretion of (D) = 1 + x

$$= 1 + \frac{9}{11} = \frac{20}{11}$$

$$= 1.8181 = 181.81 \times 10^{-2}$$

$$\approx 182 \times 10^{-2}$$

Q5 (3)

$$[NH_4^+] = 0.0504 \& [NH_3] = 0.0210$$

$$\text{So } K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

$$[\text{HO}^-] = \frac{K_b \times [\text{NH}_3]}{[\text{NH}_4^+]} = 1.8 \times 10^{-5} \times \frac{2}{5} \times \frac{210}{504}$$

$$= 3 \times 10^{-6}$$