

Question

4.6 gm of glucose ($C_6H_{12}O_6$) are dissolved in 100 gm of water. If the density of resulting solution is 0.956 gm/ml. Calculate the normality of solution.

Solution

The normality of a solution is defined as the molar concentration C divided by an equivalence factor f_{eq} :

$$Normality = \frac{C}{f_{eq}}$$

The molar concentration, C is defined as the amount of a substance n (in moles) divided by the volume of the solution V (in litres):

$$C = \frac{n}{V}$$

The n of glucose may be calculated as its mass ($m_g = 4.6$ gm) divided by molar mass of glucose ($M_g = 180.16$ gm/mol):

$$n = \frac{m_g}{M_g} = \frac{4.6}{180.16} = 0.026 \text{ moles}$$

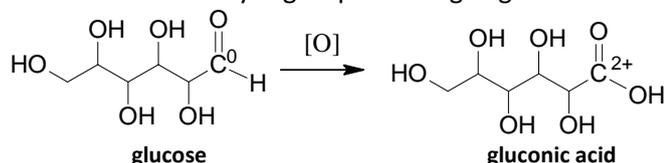
The solution volume is calculated as the solution mass (sum of masses of glucose and water) divided by its density ($\rho = 0.956$ gm/ml):

$$V = \frac{m_s}{\rho} = \frac{m_g + m_w}{\rho} = \frac{4.6 + 100}{0.956} = 109.4 \text{ ml} = 0.1094 \text{ l}$$

Now we can calculate the molar concentration:

$$C = \frac{n}{V} = \frac{0.026}{0.1094} = 0.238 \text{ mol/l}$$

In red-ox reactions, the equivalence factor f_{eq} is a value inverted to the number of electrons that an oxidizing or reducing agent can accept or donate. Glucose is a very good reducing agent. Its aldehyde group is oxidized to carboxylic group resulting in gluconic acid formation:



Glucose donate two electrons in the reaction. That is why for glucose $f_{eq} = 1/2 = 0.5$
Thus normality of the glucose solution is

$$Normality = \frac{C}{f_{eq}} = \frac{0.238}{0.5} = 0.476 \text{ Eq/l}$$

Answer: 0.476 Eq/l