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### Estimate the Mass of Urea- $\text{NH}_2\text{CONH}_2$ Required in Making 2.5 Kg of 0.25 Molal Aqueous Solution: Urea (For CBSE, ICSE, IAS, NET, NRA 2022)

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#### Urea

- Urea is a nitrogenous compound containing a carbonyl group attached to two amine groups with osmotic diuretic activity.
- Urea, also called carbamide, the diamide of carbonic acid.
- Its formula is  $\text{H}_2\text{NCONH}_2$
- Urea has important uses as a fertilizer and feed supplement, as well as a starting material for the manufacture of plastics and drugs.
- A colourless, crystalline substance melts at  $132.7^\circ\text{C}$  ( $271^\circ\text{F}$ ) and decomposes before boiling.
- Urea is used to treat dry/rough skin conditions (e. g. , eczema, psoriasis, corns, and callus) and some nail problems (e. g. , ingrown nails) .
- It may also be used to help remove dead tissue in some wounds to help wound healing.

#### Molality

$$m = \frac{\text{mol}}{\text{kg}}$$

$m$  = molality

Mol = moles of solute

Kg = kilograms of solvent

- Molality is a property of a solution and is defined as the number of moles of solute per kilogram of solvent.
- Molality is a measure of number of moles of solute present in 1 kg of solvent.

- This contrasts with the definition of molarity which is based on a specified volume of solution.
- A commonly used unit for molality in chemistry is mol/kg. A solution of concentration 1 mol/kg is also sometimes denoted as 1 molal.
- The SI unit for molality is mol/kg. A solution with a molality of 3 mol/kg is often described as “3 molal” or “3 m.”
- So, following the SI system of units, mol/kg or a related SI unit is now preferred.

## Mass of Urea

- Mass of solution = 2.5 Kg
- Molality = 0.25 m
- Molar mass of urea ( NH<sub>2</sub> CONH<sub>2</sub> )
  - = (14 + 2 × 1 + 12 + 16 + 14 + 2 × 1)
  - = 60g mol<sup>-1</sup>
- Mass of urea = Number of moles of urea × Molar mass of urea
- Mass of 0.25 moles of urea = 0.25 mol × 60g mol<sup>-1</sup> = 15g
- Mass of solution = 1000 g + 15 g = 1015 g
- 1015 g of aqueous solution contains urea = 15g

∴ 2500 g of aqueous solution will require urea

$$= \frac{15\text{g}}{1015} \text{kg} \times 2500\text{g}$$

$$= 36.95\text{g}$$

$$\cong 37\text{g}$$

Mass of urea required in making 25 grams of 0.25 m = **37 grams**

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