



أكاديمية القصور

تعلمكم بدء الدورات لمادة

Chemistry 101

Physics 101

Calculus 101

biology 101

(كما تعلمكم بوجود تلاميذ و أسئلة لهذه المادة)

للتسجيل إرسال رسالة قصيرة الى الرقم 0785706008

على ان تحتوي (اسم الطالب ، المادة ، التخصص ، رقم خطوي الطالب)

Chapter 4: Reactions in Aqueous Solution

4.5 Concentration of solutions

Definition: the amount of solute present in a given quantity of solvent or solution, consider the solute is a liquid or a solid and the solvent is liquid.

Molarity "Molar Concentration": number of moles of solute in one liter of solution.

$$\text{Molarity (M)} = \frac{\text{moles of solute}}{\text{liters of solution}}$$

$$M = \frac{n}{V_L}$$

أكاديمية القصور



Notes:

- Molarity is an intensive property
- Molarity refers to the amount of solute originally dissolved in water and does not take into account any subsequent processes, such as ionization of acid

Ex 1: Calculate the molarity of an 85 mL ethanol solution containing 1.77g of ethanol (46.0g/mol)?

Ans.: 0.45 M

$$M = \frac{\text{moles}}{V(L)}$$

$$n = \frac{1.77}{46} = 0.038 \text{ mol}$$

$$M = \frac{n}{V} = \frac{0.038}{85} = 0.45$$

Ex 2: How many grams of potassium dichromate ($K_2Cr_2O_7$) (294.2 g/mol) are required to prepare a 250mL solution whose concentration is 2.16M?

Ans.: 159 g

$$M = \frac{n}{V_L}$$

$$n = \frac{m}{MM}$$

$$2.16 = \frac{n}{250}$$

$$\Rightarrow n = 540$$

$$540 = \frac{m}{294.2} \Rightarrow m = 158868g$$

Electrolyte: exist as ions in solution, such as NaCl and KCl. 1.0 M KCl solution contains 1.0 mole K^+ ions and 1.0 mole Cl^- ions and no KCl are present. (KCl is a strong electrolyte).

Nonelectrolyte: do not break up into ions. Such as glucose 1.0M solution contains 1.0 mole glucose molecules.

Note: Elements of GIA, GIIA, and GIIIA produce ions 'Electrolyte Solutions'

Strong Electrolytes

HCl, HBr, HI

HNO₃

HClO₄

H₂SO₄

KBr

NaCl

NaOH, KOH

Other soluble ionic compounds

Weak Electrolytes

CH₃CO₂H

HF

Nonelectrolytes

H₂O

CH₃OH

C₂H₅OH

C₁₂H₂₂O₁₁ (sucrose)

Most compounds of carbon



Ex.1: A 250 mL sample of solution contains 4.30 g of CaCl_2 . Calculate the molar concentration of Cl^- in this solution?

Ans:

$$M_{\text{CaCl}_2} = n/V$$

$$= (4.30\text{g}/111\text{g/mol})/0.250\text{L} = 0.155 \text{ mol/L}$$

$$M_{\text{Cl}^-} = (2/1) \times 0.155 = 0.31 \text{ mol/L}$$

Ex.2 How many grams of Cl^- are in 300 mL of the solution in Ex.1?

Ans:

$$n = MV$$

$$= 0.31 \times 0.3 \text{ L} = 0.093 \text{ mol}$$

$$\gg m = n \times \text{Mwt.}$$

$$= 0.093 \times 35.4 = 3.3 \text{ g}$$

الحلول المخففة
Dilution of solutions

Dilution: preparing a less concentrated solution from a more concentrated one.

Q. How to prepare 1L of a 0.40M KMnO_4 solution from a solution of 1.0M KMnO_4 ?

Note:

- No. of moles of solute is not changing in dilution but the volume of solvent is changed.
- Since molarity is number of moles of solute in 1.0L of solution, then the number of moles is given by:

$$\frac{\text{moles of solute}}{\text{liters of solution}} \times \text{volume of solution (L)} = \text{moles of solute}$$

\Downarrow
M

\Downarrow
V

\Downarrow
n

moles before diluting = moles after diluting

In conclusion,



$$M_i V_i = M_f V_f$$

M_i , M_f initial and final concentrations of solutions in Molar(mol/L)

V_i , V_f initial and final volumes of solutions in (L)

Ex. 1: how would you prepare 2×10^2 mL of a 0.866M NaOH solution, starting with a 5.07M stock solution?

Ans.:

$$M_i \times V_i = M_f \times V_f$$

$$5.07M \times V_i = 0.866M \times 2 \times 10^2 \text{ ml}$$

$$V_i = (0.866M \times 2 \times 10^2 \text{ ml}) / 5.07M$$

$$= 34.16 \text{ ml (taking from stock solution to prepare NaOH solution)}$$

$$\text{Solvent added} = V_f - V_i$$

Ex. 2: The molarity of "concentrated" HCl purchased for laboratory use is approximately 12.1 M. How many milliliters of this reagent should be diluted to 1.0 L to make 0.10 M HCl?

Note:

When mix two solutions you may use:

$$n_1 = n_2$$

$$(n_a + n_b) = n_2$$

$$[(MV)_a + (MV)_b]_1 = (MV)_2$$



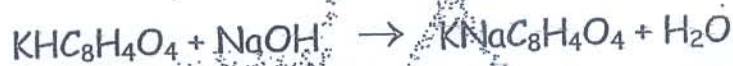
4.6 Solution Stoichiometry and chemical analysis

Titration: ^{تربير} a solution of known concentration, called "*standard solution*", is added ^{حلول نموذجية} gradually to another solution of unknown concentration, until the chemical reaction between the two solutions is complete. ^{المعايرة}

NOTE: knowing the volumes of standard and unknown solutions, along with the concentration of standard solution, this enable to calculate the concentration of unknown solution.

Sometimes, standard solutions must be "standardized" before using them in titrations; this process is accomplished by titrate the standard solution against a solution of accurately known concentration.

Ex. NaOH is standardized by using a monoprotic acid called potassium hydrogen phthalate (KHP).



Equivalence point: the point at which the acid has completely reacted with or been neutralized by the base.

Note: in titration of KHP with NaOH, at the equivalence point:

$$\text{Moles KHP} (M \times V) = \text{moles NaOH} (M \times V)$$

Indicator: substance that has distinctly different colors in acidic and basic media.

Ex. "Phenolphthaleine" (ph.ph.) as an example is colorless in acidic and neutral media, reddish pink in basic media.

In general,

$$\text{moles H}^+ = \text{moles OH}^-$$



or



$\frac{\text{moles A}}{a} = \frac{\text{moles B}}{b}$

Ex 1: A student finds that 0.5468g of KHP (MM=204 g/mol) is needed to completely neutralize 23.48mL of NaOH solution, calculate the molarity of NaOH solution?



Ex 2: How many milliliters of a 0.61 M NaOH are needed to neutralize 20mL of a 0.245M H₂SO₄ solution?

Ex 3: Calculate the volume of 0.5 M HCl solution needed to neutralize with 10 mL of a 0.2 M Ba(OH)₂ ?

Redox Reactions

تفاعلات الأكسدة والاختزال
يعمل

A reaction involves transfer of electrons from one substance to another.

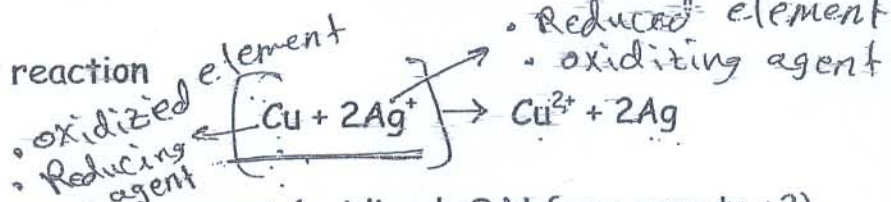
Remember

Oxidizing agent: a substance that gains electrons (increasing in oxidation number)

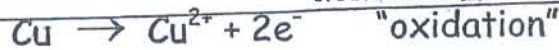
Reducing agent: a substance that loses electrons (decreasing in oxidation number)

عامل مختزل

Ex: for the redox reaction



Cu is considered as reducing agent (oxidized, O.N from zero to +2)



Ag is considered as oxidizing agent (reduced, O.N from +1 to zero)

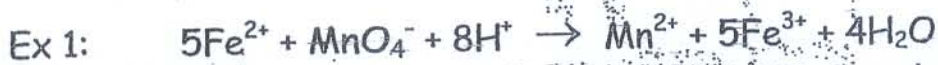
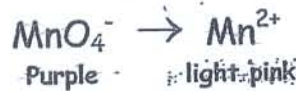
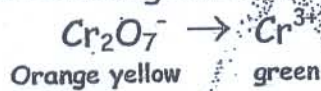


As in acid base titration, we can titrate an oxidizing agent against a reducing agent, using same procedure.

Equivalence point: a point when the reducing agent is completely oxidized by the oxidizing agent.

In redox reactions, some oxidizing agents can be used as indicators, these called "*Internal Indicator*", because they have different colors in the oxidized and reduced forms.

Ex. Dichromate and Permanganate anions...



In this redox reaction, 16.42mL of 0.1327M KMnO_4 solution is needed to oxidize 20mL of a FeSO_4 solution in an acidic medium. Calculate the concentration of the FeSO_4 solution.

Ans.:

$$n_{(\text{Fe}^{2+})} = n_{(\text{MnO}_4^-)}$$

$$\frac{(M \times V)^+}{5} = \frac{(M \times V)^-}{1}$$

$$\square M = \frac{5(M \times V)^-}{V^+}$$

$$= \frac{5 \times 16.42\text{ml} \times 0.1327\text{M}}{20\text{ml}}$$

$$= 0.545 \text{ M}$$



Years Questions

- 1) Calculate the molarity of 6.57g of methanol (CH_3OH) in 1.50×10^2 mL of solution?
A. 13.7M B. 1.37M C. 12.05M D. 2.23M
- 2) Determine how many grams of sodium carbonate (Na_2CO_3) would be needed to make 2.50×10^2 mL of a 0.1 M solution?
A. 2.58 g B. 2.65 g C. 4.58 g D. 5.20 g
- 3) You have 505 mL of a 0.125 M HCl solution and you want to dilute it to exactly 0.10 M, How much water should you add?
A. 114 ml B. 66 ml C. 78 ml D. 126 ml
- 4) A 46.2-mL, 0.568 M calcium nitrate $\text{Ca}(\text{NO}_3)_2$ solution is mixed with 80.5 mL of 1.396 M calcium nitrate solution. Calculate the concentration of the final solution?
A. 2.8M B. 2.2M C. 1.1M D. 0.8M
- 5) What volume of a 0.500 M HCL solution is needed to neutralize 10 mL of a 0.2 M $\text{Ba}(\text{OH})_2$ solution?
A. 2 ml B. 4 ml C. 6 ml D. 8 ml
- 6) Calculate the volume of a 0.206M HI solution that needed to reduce 22.5mL of a 0.374M KMnO_4 solution?
$$10\text{HI} + 2\text{KMnO}_4 + 3\text{H}_2\text{SO}_4 \rightarrow 5\text{I}_2 + 2\text{MnSO}_4 + 8\text{H}_2\text{O}$$

A. 0.204L B. 20.2L C. 4.12L D. 0.94L



The Solution

Question No.	Answer
1	B
2	B
3	D
4	C
5	D
6	A

أكاديمية القصور

تستقبلكم وتستقبل اتصالاتكم

يوميًا من الساعة 12:30 ظهراً و لغاية الساعة 12:30 ليلاً

*للتسجيل بالدورات 0785706008

*للاستفسار عن التلاخيص 0788802046

ALQUSOUR
ACADEMY
تستقبلكم