UNIVERSITE LIBANAISE
FACULTE DE GENIE

الجامعة اللبنانية
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Entrance Exam (2021 – 2022)
Chemistry exam Set 1

Duration: 40 min **August: 2021**

This Test consists of two Multiple-choice Exercises (MCQs).
Each Exercise consists of 10 MCQs.

1. ***Post your answer on the grille of MCQ without justification.***
2. ***For each MCQ correspond 4 proposals a, b, c, d.***
3. ***For each MCQ, there is ONLY one good answer.***
4. ***Select the correct proposal and mark the corresponding letter (a, b, c, or d) with "X" in the GRILLE associated with the exercise.***
5. ***You must answer all the questions.***
6. ***Each correct answer provides you 1 point.***
7. ***The use of non-programmable calculator is authorized.***

Grille of exercise-1

QCM N º	a	b	c	d
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Grille of exercise-2

QCM N º	a	b	c	d
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Exercise- 1
Acid-base Titration

A beaker contains a volume V_A = 20 mL of an aqueous solution of hydrochloric acid ($H_3O^+ + Cl^-$) of concentration $C_A = 2.5\times10^{-2}$ mol / L.
This solution is titrated by an aqueous basic solution (B) of sodium hydroxide (Na^++HO^-) of concentration $C_B = 5.0\times10^{-2}$ mol / L.
The pH was follow-up according to the added volume of the base (B).

1- The equation of the titration reaction is:
   a- H_3O^+ aq + Na ⟶ Na^+aq + H_2O(l).
   b- H_2O (l)+NaOH aq ⟶ Na^+aq + H_3 O^+ aq.
   c- H_3O^+aq + HO^- aq ⟶ 2 H_2O(l).
   d- H_3O^+aq + HO^- aq ⇌ 2 H_2O(l).

2- The volume of the sodium hydroxide solution required to obtain the acid-base equivalence is:
a- V_{eq} = 40 mL.
b- V_{eq} = 20 mL.
c- V_{eq} = 10 mL.
d- V_{eq} = 5 mL.

3- The acid-base equivalence is reached for:
   a- pH =1.3.
   b- pH =7.
   c- pH < 7.
   d- pH = 12.7.

4- Just before the equivalence ($V_B < V_{B\,eq}$), the expression of pH of the reaction system is:
   a- pH =1.3 - log [(C_B+V_B) / (20+V_B)].
   b- pH = 1.7 - log [(C_B10 + C_BV_B) / (20+V_B)].
   c- pH = 1.3 +log [(10 -V_B) / (20+V_B)].
   d- pH = 1.3 - log [(10 - V_B)/(20 +V_B)]

5- For $V_B = V_{B\,eq} / 2$, the pH of the reaction medium is:
   a- pH = 10
   b- pH = 9.2
   c- pH = 2.0
   d- pH = 1.3

6- At equivalence, the specie which determine the pH is:
   a- Na+ ion.
   b- Cl^- ion.
   c- Water molecule.
   d- HCl molecule.

7- For a large volume added of NaOH the pH will be:

a- pH =14.
b- pH ≤12.7.
c- pH < 7.
d- 7< pH <10.

8- For a volume $V_B = 2\ V_{B\ eq}$, the pH is:

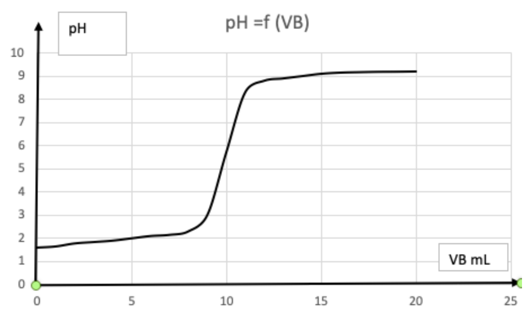
a- pH = 2.0.
b- pH = 7.0
c- pH = 12.1.
d- pH = 12.7.

9- In order to trace the shape of the curve pH = f (V_B), in the interval 0 mL<V_B<20 mL, the pH is recorded for a volume V_B = 15 mL, the expected value of pH is:

a- $pH_{(VB)= 15\ mL)}$ = 7.0.
b- $pH_{(VB)= 15\ mL)}$ = 11.9.
c- $pH_{(VB)= 15\ mL)}$ = 12.7.
d- $pH_{(VB)= 15\ mL)}$ = 13.3.

10- The characteristics of this shape are:

a- Formed of 4 steps (parts), (increasing, slightly increasing, strongly increasing, slightly increasing), has 2 inflection points, starts with pHi = 2.0 and ends with pH_f ≤12.7.
b- Formed of 3 steps, (slightly increasing, strongly increasing, slightly increasing), has 1 inflection point, starts with pHi = 1.6 and ends with pH_f ≤12.7.
c- Formed of 3 steps, (slightly increasing, strongly increasing, slightly increasing), has 1 inflection point, starts with pHi = 2 and ends with pH_f =9.2.
d- Formed of 3 steps, (slightly increasing, strongly increasing, slightly increasing), has 2 inflection points, starts with pHi =1.6 and ends with pH_f ≤ 9.



Exercise- 2

Kinetic

I- It is required to study the kinetics of the following slow and complete reaction:

$$H_2O_{2(aq)} + 2I^-_{(aq)} + 2H^+_{(aq)} \longrightarrow I_{2(aq)} + 2H_2O_{(l)}$$

Starting with the following solutions:

- (A) of H_2O_2 of concentration $C_A=2\times10^{-2}$ mol/L.
- (B) of KI of concentration $C_B= 0.4$ mol/L.
- (C) of H_2SO_4 of concentration $C_C=5\times10^{-2}$ mol/L.

1- The solution (A) is obtained by dilution of a commercial solution of H_2O_2 of concentration 1 mol/L. The lot of needed glassware to prepare (A) is:

a- A volumetric flask of 250 mL and a volumetric pipet of 10 mL.
b- A volumetric flask of 250 mL and a volumetric pipet of 5 mL.
c- A volumetric flask of 200 mL and a volumetric pipet of 10 mL.
d- A volumetric flask of 50 mL and a volumetric pipet of 2 mL.

2- Solution (B) is obtained by dissolution of potassium iodide KI solid of M_{KI}=166g/mol.

To obtain:

a- 100 mL of (B) it is necessary to dissolve 3.32 g of KI.
b- 250 mL of (B) it is necessary to dissolve 6.64 g of KI.
c- 100 mL of (B) it is necessary to dissolve 6.64 g of KI.
d- 500 mL of (B) it is necessary to dissolve 3.32 g of KI.

3- Sulfuric acid is a strong diacid: $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$

The pH of the sulfuric acid solution(C) is

a- $pH_{(C)} = 2.3$.
b- $pH_{(C)} = 2.0$.
c- $pH_{(C)} = 1.3$.
d- $pH_{(C)} = 1.0$.

II- At the instant t = 0 min,

- 100 mL of (A) of H_2O_2 of concentration $C_A=2\times10^{-2}$ mol/L.
- 40 mL of (B) of KI of concentration $C_B= 0.4$ mol/L.
- 60 mL of (C) of H_2SO_4 of concentration $C_C=1\times10^{-2}$ mol/L.

are mixed into a beaker of 500 mL.

4- The limiting reactant is:

a- H_2O_2.
b- I^-.
c- H^+.
d- I_2.

5- The initial concentration in the mixture of :

a- H_2O_2 is $[H_2O_2]_{t=0}= 1\times10^{-2}$mol/L.
b- H_2O_2 is $[H_2O_2]_{t=0}= 5\times10^{-3}$mol/L.
c- I^- is $[I^-]_{t=0}= 4\times10^{-2}$mol/L.
d- H^+ is $[H^+]_{t=0}= 2\times10^{-2}$mol/L.

6- The final concentration in the mixture of:

a- H_2O_2 is $[H_2O_2]_{t\ final} = 1\times10^{-2}$mol/L.

b- I_2 is $[I_2]_{t\ final} = 1\times10^{-2}$mol/L.

c- I^- is $[I^-]_{t\ final} = 8\times10^{-2}$mol/L.

d- H^+ is $[H^+]_{t\ final} = 2\times10^{-2}$mol/L.

III- In order to be able to follow the kinetic evolution of the slow and complete reaction:

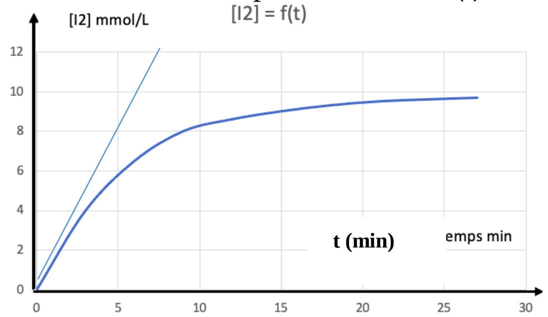
$$H_2O_{2(aq)} + 2I^-_{(aq)} + 2H^+_{(aq)} \longrightarrow I_{2(aq)} + 2H_2O_{(l)}$$

A volume V=20 mL is taken at different times every 3 minutes and poured into 150 mL of ice water mixed with starch (colorless indicator and colored blue in the presence of iodine).

The obtained solution is titrated with a sodium thiosulfate solution of concentration 2×10^{-3}mol/L. The equation of the titration reaction is:

$$I_{2\,(aq)} + 2S_2O_3^{2-}{}_{(aq)} \longrightarrow 2I^-_{(aq)} + S_4O_{6(aq)}^{2-}$$

The curve below represents $[I_2] = f(t)$



Time min	$[I_2]$ mmol.L^{-1}
0	0
3	4
6	6.5
9	8
12	8.6
15	9
18	9.3
21	9.5
24	9.6
27	9.68

7- The formation rate of I_2 over time:

a- Decreases.

b- Increases.

c- Does not vary.

d- Depends on the concentration of I_2.

8- The role of ice water is to:

a- Increase the rate of the formation reaction of iodine.

b- Blok the formation of iodine.

c- Increase the concentration of iodine.

d- Increase the concentration of the limiting reactant.

9- The relation giving $[I_2]_t$ as function of the volume V_E of thiosulfate poured at equivalence is:

a- $[I_2]_t=2\times10^{-5}\times V_E$.

b- $[I_2]_t=5\times10^{-5}/V_E$.

c- $[I_2]_t=5\times10^{-5}\times V_E$.

d- $[I_2]_t=1\times10^{-5}\times V_E$.

10- The volume V_E poured at equivalence

a- Decreases over time.

b- Increases over time.

c- Does not vary over time.

d- Is determined by turning from colorless to blue.