



جامعة إيبلا الخاصة

كلية الصيدلة



جامعة حلب كلية العلوم/قسم الكيمياء/

الفصل الأول

أساسيات العمل المخبري

-1-1

-1

-2

-3

-4

-5

-6

-7

-8

-9

-10

-11

-12

-13

-14

-15

-16

-2-1

-1

-2

-3

-4

-5







-6

-7

-3-1

(1-1)

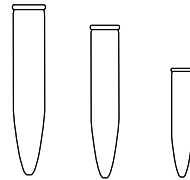
: (1-1)

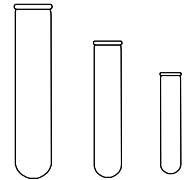
-4-1

-1

. (1-1)



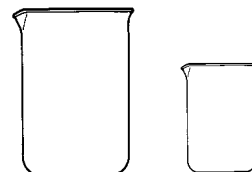
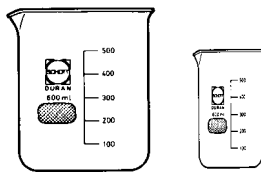
: (1-1)



-2

. (2-1)

5L 5mL



: (2-1)

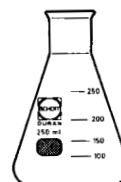
-3

(3-1-a)

. (3-1-b)



: (b)



: (a)



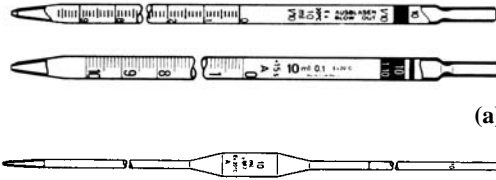
: (3-1)

-4

(mL)

. (4-1-a)

. (4-1-b)



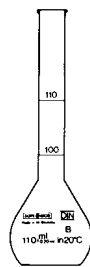
(a)

(b)

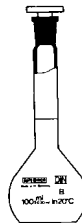
: (4-1)

-5

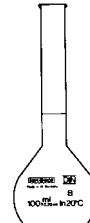
. (5-1)



(c)



(b)

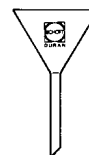
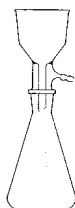


(a)

: (5-1)

-6

. (6-1)



: (6-1)

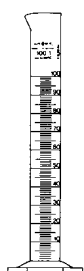
-7



: (7-1)

. (7-1)

-8



(b)



(a)

: (8-1)

. (8-1)

-9



(b)



(a)

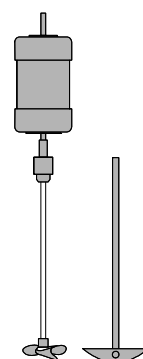
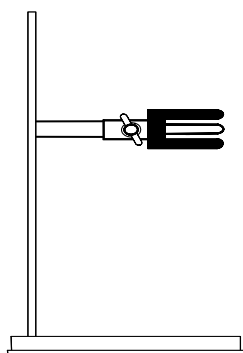
: (9-1)

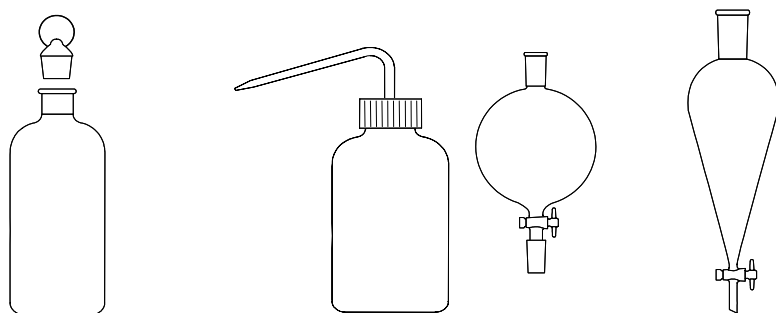
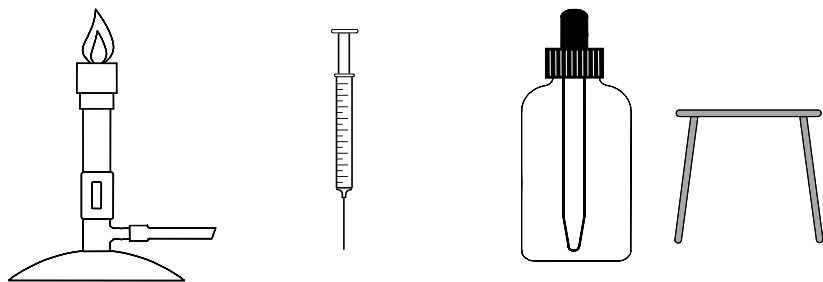
. (9-1)

-10

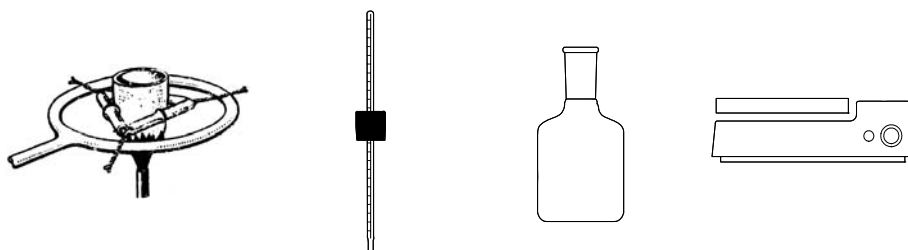
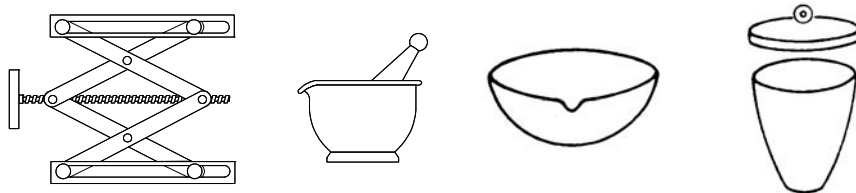
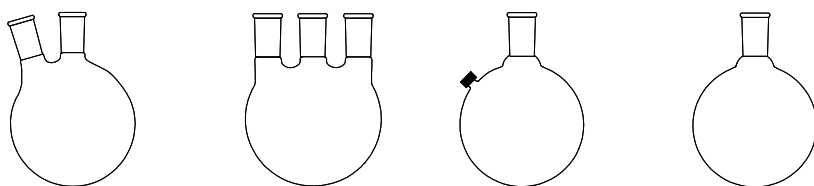
:

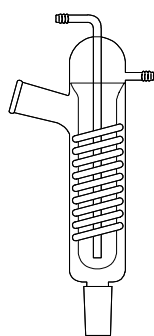
. (10-1)



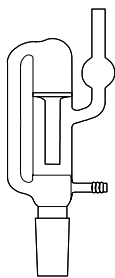


: (10-1)





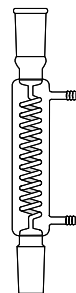
d



c



b



a

: (10-1)

-5-1

-1

-2

2-5ml

. 5%

-3

. 6%

5N

-4

-5

500ml

100g

1/2L

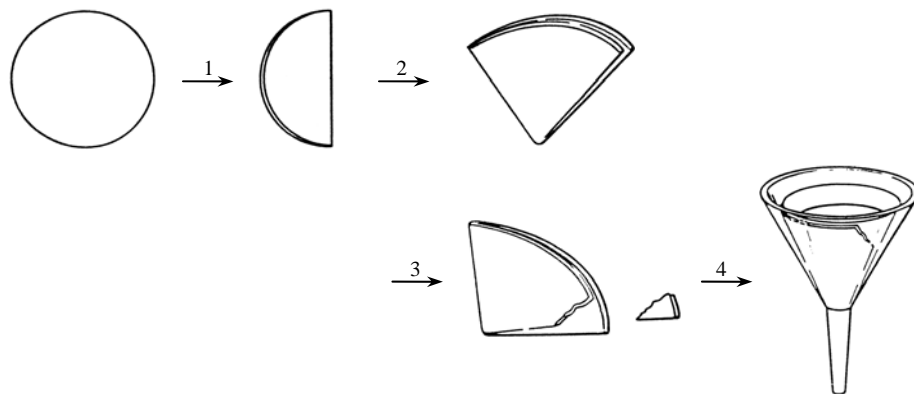
-6-1

-1-6-1

-2-6-1

-3-6-1

. (11-1)



: (11-1)

-7-1

-1-7-1

:

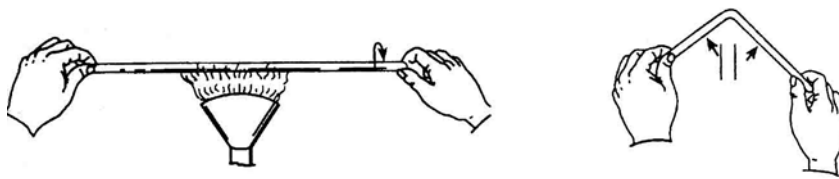
. (12-1)



: (12-1)

2-7-1

. (13-1)



: (12-1)

3-7-1

20cm

5mm

()

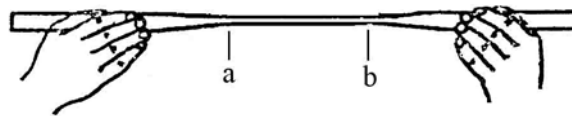
)

a

(

. (31-1)

b



: (13-1)

الفصل الثاني

pH المدليل والمدليل الواقية

pH

pH

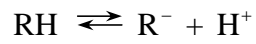
pH

-1-2

RH

. ROH

:



R⁻

RH

()

R⁻

(1-2)

:

pH

: (1-2)

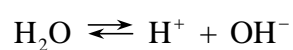
	1.2 - 2.8		
	2.9 - 4.0		
	3.0 - 4.6		
	3.1 - 4.4		()
	3.8 - 5.4		
	4.4 - 6.2		
	4.8 - 6.4		

	5.0 - 8.0		
	5.2 - 6.8		
	6.0 - 7.6		
	6.4 - 8.2		
	6.8 - 8.0		
	0.2 - 1.8		
	8.0 - 9.6		
	8.0 - 10.0		
	9.3 - 10.5		
	10.0 - 11.1		
	10.0 - 12.1		

pH

-2-2

:



:

$$K = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$$

$$K[\text{H}_2\text{O}] = [\text{H}^+][\text{OH}^-]$$

K[H₂O]

20°C

K_w

.

K_w

. 10⁻¹⁴mol/L

$$K_w = [\text{H}^+][\text{OH}^-] = 10^{-14} \text{mol/L}$$

:

$$[\text{H}^+] = [\text{OH}^-] = \sqrt{10^{-14}} = 10^{-7}$$

:

$$\text{pH} = -\log[\text{H}^+]$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pK}_w = -\log K_w$$

:

$$pK_w = pH + pOH = 14$$

:

$$pH = 14 - pOH$$

:

$$[H^+] = [OH^-] = 10^{-7}$$

$$pH = pOH = 7$$

$$pH < 7$$

$$[OH^-] < 10^{-7} \quad [H^+] > 10^{-7} \\ \therefore pOH > 7$$

$$[OH^-] > 10^{-7} \quad [H^+] < 10^{-7}$$

$$\therefore pOH < 7 \quad pH > 7$$

()

pH -3-2

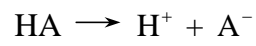


C

[HA]mol/L

HA

:



C_a

C

C

$$[HA] = [H^+]$$

:

pH

$$pH = -\log C_a$$

()

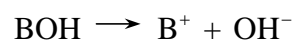
pH -4-2

C

[BOH] mol/L

BOH

:



C_b

C

C

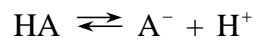
pOH

$$pOH = -\log[OH^-]$$

$$\text{pH} + \text{pOH} = 14 \quad :$$

$$\text{pH} = 14 - \text{pOH} \quad (\quad) \quad \text{pH -5-2}$$

HA :



$$K_a = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]}$$

$$[\text{H}^+] = [\text{A}^-]$$

$$K_a = \frac{[\text{H}^+]^2}{[\text{HA}](1-a)}$$

HA : a

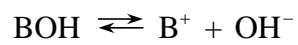
$$[\text{H}^+]^2 = K_a[\text{HA}]$$

:

$$\text{pH} = \frac{\text{p}K_a - \log C_a}{2}$$

$$(\quad) \quad \text{pH -6-2}$$

:



$$K_b = \frac{[\text{B}^+][\text{OH}^-]}{[\text{BOH}]}$$

$$[\text{B}^+] = [\text{OH}^-]$$

$$K_b = \frac{[\text{OH}^-]^2}{[\text{BOH}](1-a)}$$

BOH : a

$$[\text{OH}^-]^2 = K_b[\text{BOH}]$$

:

$$\text{pOH} = \frac{\text{p}K_b - \log C_b}{2}$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - \frac{\text{p}K_{\text{b}} + \log C_{\text{b}}}{2}$$

-7-2

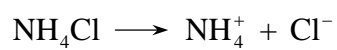


pH

pH

-1-7-2

:



:

pH

$$\text{pH} = 14 - \left[\text{p}K_{\text{b}} + \log \frac{C_{\text{s}}}{C_{\text{b}}} \right]$$

K_{b}

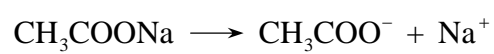
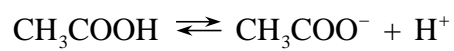
C_{b}

C_{s}

-2-7-2



:



:

pH

$$\text{pH} = \text{pK}_a + \log \frac{C_s}{C_a}$$

التجارب العملية

-1 :

- (6) .

- .

- (5mL) .

-2 :

-

- pH

- 0.1N 0.1N

- 1N 0.1N

- 0.1N 1N

-3 :

- :

1mL

. 0.1N

: .

pH	pH				
					1
					2
					3

pH

pH

)

pH

pH

. (

- :

. 0.1N

pH	pH				
					1
					2

					3
--	--	--	--	--	---

: -

0.1N

1mL

1mL

.

pH

pH

. $pK_b = 4.75$

$pK_a = 4.73$

: -

2mL

0.1N

2mL

. (pH)

0.1N

0.5mL

.

5ml

. 0.1N

(pH)

pH

pH

.

pH

.

pH

. $pK_a = 4.73$

.

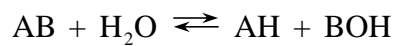
0.1N

الفصل الثالث

المقدمة العامة

-1-3

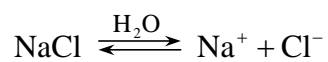
:



.

.

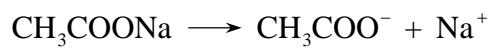
:



:

-1-1-3

:



:



OH^-

CH_3COOH

:

pH

$$pH = 7 + \frac{pK_a + \log C_s}{2}$$

C_s

K_a

. pH > 7

-2-1-3

NH_4Cl

:

NH_3

HCl





$$\text{pH} > 7$$



:

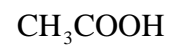
pH

$$\text{pH} = 7 - \frac{\text{pK}_b + \log C_s}{2}$$

:

-3-1-3

:



:

pH

$$\text{pH} = 7 + \frac{\text{pK}_a - \text{pK}_b}{2}$$

$$\text{pH} < 7 \quad \text{pK}_a < \text{pK}_b$$

$$\text{pH} \approx 7$$

$$\text{pK}_a \approx \text{pK}_b$$

$$\text{pH} > 7$$

$$\text{pK}_a > \text{pK}_b$$

.

-2-1

:



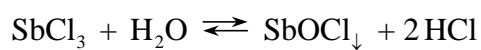
()

:



.

()



SbOCl

التجارب العملية

-1

(6)

-2

0.1N

-

0.1N

-

0.1N

-

0.1N

-

0.1N

-

0.1N

-

0.1N

-

0.1N

-

-

0.1N

-

-

0.1N

-

-3

:

-

:

1mL

)

(

:

pH

-

-

-

-

-

:

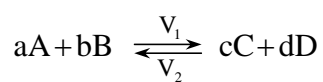
				pH	

الفصل الرابع

مبدأ لوشاتولييه والتوازن الكيميائي

-1-4

: C D B A



: V_1

$$v_1 = k_1 [A]^a [B]^b$$

: V_2

$$v_2 = k_2 [C]^c [D]^d$$

: $k_2 > k_1$

:

$$k_1 [A]^a [B]^b = k_2 [C]^c [D]^d$$

: K_e

$$\frac{k_1}{k_2} = K_e = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

K_e

.

.

.

.

: $K_e > 1$ -

.

: $K_e < 1$ -

: $K_e = 1$ -

.

"

()

()

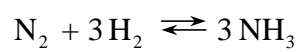
."

-2-4

-3-4

()

:



()

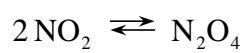
.()

4-4

:

15Kcal

:



$\Delta H = -15\text{Kcal}$

)

)

NO₂

N₂O₄

(

(

·

:

-1

(4)

-2

. 0.1N KSCN

. 0.1N FeCl₃

. CuSO₄.5H₂O

. 0.1N K₂CrO₄

. 0.1N

. Pb(NO₃)₂

. (NaCl)

:

:

1mL

FeCl₃

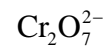
1mL

3N

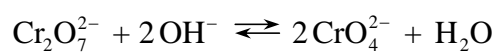


. ()

:



:



()

. ()

:

1mL

0.1N

:

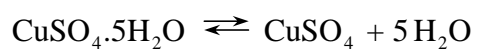
-

50mL

$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

1g

5min

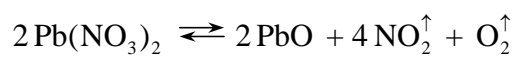


:

-

$\text{Pb}(\text{NO}_3)_2$

:



. NO_2

:

()

.

الفصل الخامس

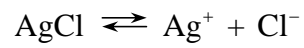
النوارات في الجمل غير المنجاسة

-1-5

pH

AgCl

:



:

$$K = \frac{[\text{Ag}^+][\text{Cl}^-]}{[\text{AgCl}]}$$

: AgCl

$$K[\text{AgCl}] = [\text{Ag}^+][\text{Cl}^-] = \text{const}$$

$$K[\text{AgCl}]$$

:

$$[\text{Ag}^+][\text{Cl}^-]$$

K_{sp}

$$K_{\text{sp,AgCl}} = [\text{Ag}^+][\text{Cl}^-]$$

:

$$K_{\text{sp}} > [\text{Ag}^+][\text{Cl}^-] :$$

. ()

$$K_{\text{sp}} < [\text{Ag}^+][\text{Cl}^-] :$$

)

AgCl

. (

$$K_{sp} = [Ag^+][Cl^-] :$$

التجارب العملية

-1 :

(4) -
-
-

-2 :

0.4N - 0.4N -
- -
- 0.2N -
- -
- 0.2N -
0.2N -

- :

2mL

.

() .

- :

2mL

1mL

1mL

.

1mL

1mL

.

.

- :

2mL

1mL

2mL

)

2mL

(2mL

.

.

:

2mL

•

•

•

—

. $\text{Ca}(\text{OH})_2$

25mL

0.1N

•

.

•

•

$$NV = N'V'$$

•

$$: N$$

. 25mL

$$\vdots \quad \mathbf{V}$$

. 0.1N

$$: N'$$

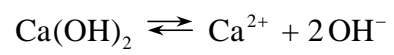
•

$$\vdots V'$$

•

•

:


$$\vdots$$

$$K_{sp} = [Ca^{2+}][OH^{-}]^2$$

•

$$K_{sp}$$

• ()

الفصل السادس

نابون لأفواريه ومصونية المادة

-1-6

·
:
()
" "

:

-1

-2

-3

-4

-5

-6

التجارب العملية

-1

:

-

-

-

-2

:

-

4N

-

6N

-

2N

-

1N

-

-

(

):

-

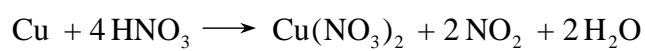
2mL

()

0.5gr

)

. (



(

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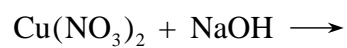
NaOH

()

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20mL

()



(

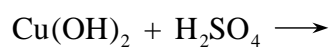
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H₂SO₄

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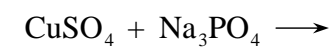


(

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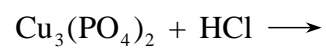
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() : -

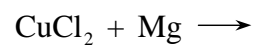
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() : -

5mL

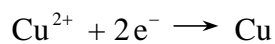
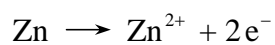
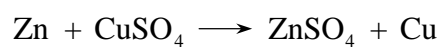
:



الفصل السابع

الكسدة والرجاع

-1-7



(1-7)

: (1.7)

	$E^{\circ} \text{ (V)}$
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	- 3.04
$\text{Cs}^{+} + \text{e}^{-} \rightleftharpoons \text{Cs}$	- 3.02
$\text{K}^{+} + \text{e}^{-} \rightleftharpoons \text{K}_{\downarrow}$	- 2.92
$\text{Ba}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ba}_{\downarrow}$	- 2.90
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}_{\downarrow}$	- 2.87
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}_{\downarrow}$	- 2.71
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}_{\downarrow}$	- 2.37
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}_{\downarrow}$	- 1.66
$\text{U}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{U}$	- 1.80

$\text{Ti}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ti}$	- 1.63
$\text{Zr}^{4+} + 4\text{e}^- \rightleftharpoons \text{Zr}$	-1.53
$\text{Mn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Mn}_{\downarrow}$	- 1.18
$\text{Zn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Zn}_{\downarrow}$	- 0.76
$\text{Cr}^{3+} + 3\text{e}^- \rightleftharpoons \text{Cr}_{\downarrow}$	- 0.74
$\text{Fe}^{2+} + 2\text{e}^- \rightleftharpoons \text{Fe}_{\downarrow}$	- 0.44
$\text{Tl}^+ + \text{e}^- \rightleftharpoons \text{Tl}$	- 0.336
$\text{Co}^{2+} + 2\text{e}^- \rightleftharpoons \text{Co}_{\downarrow}$	- 0.28
$\text{Ni}^{2+} + 2\text{e}^- \rightleftharpoons \text{Ni}_{\downarrow}$	- 0.25
$\text{Sn}^{2+} + 2\text{e}^- \rightleftharpoons \text{Sn}_{\downarrow}$	- 0.136
$\text{Pb}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pb}_{\downarrow}$	- 0.126
$2\text{H}^+ + 2\text{e}^- \rightleftharpoons \text{H}_2$	0.00
$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu}$	+0.337
$\text{Cu}^+ + \text{e}^- \rightleftharpoons \text{Cu}$	+ 0.521
$\text{Ag}^+ + \text{e}^- \rightleftharpoons \text{Ag}_{\downarrow}$	+ 0.80
$\text{Pd}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pd}$	+0.987
$\text{Pt}^{2+} + 2\text{e}^- \rightleftharpoons \text{Pt}$	+1.20
$\text{Au}^{3+} + 3\text{e}^- \rightleftharpoons \text{Au}$	+ 1.50

-2-7

-1

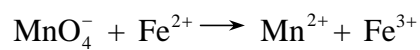
-2

-1

-2

H₂O

H^+ : -3
 OH^- : -
 e^- : -
 e^- : -4
 e^- : -5
 e^- : -6
 e^- : -7
-1-2-7
1

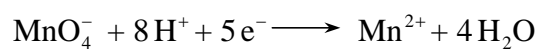


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$$X + (-2 \times 4) = -1 \Rightarrow X = +7$$

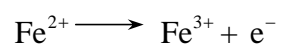


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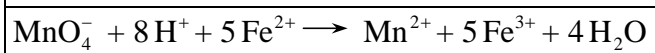


$\times 5$

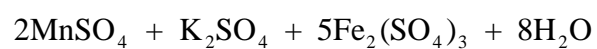
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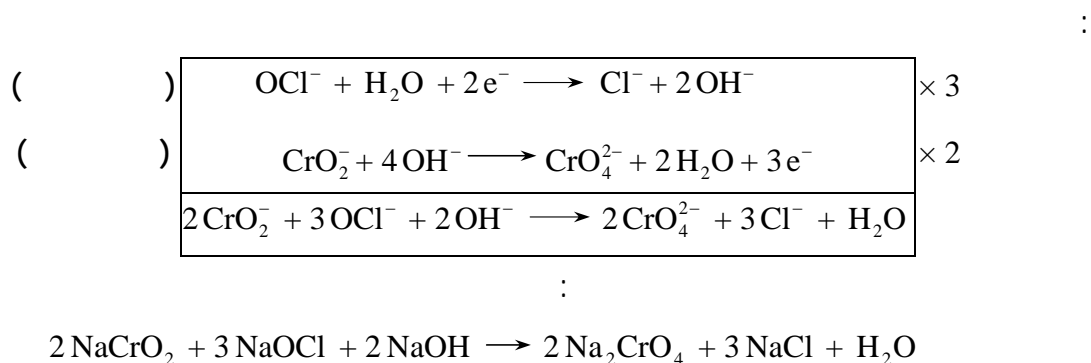
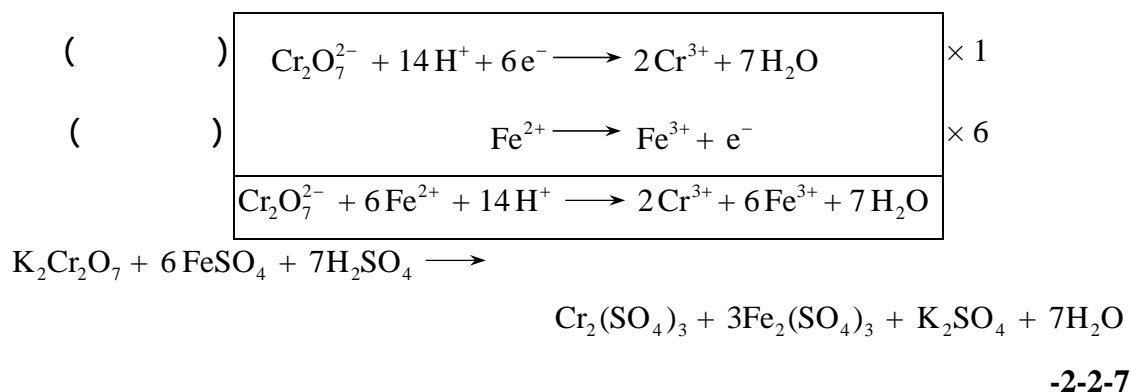
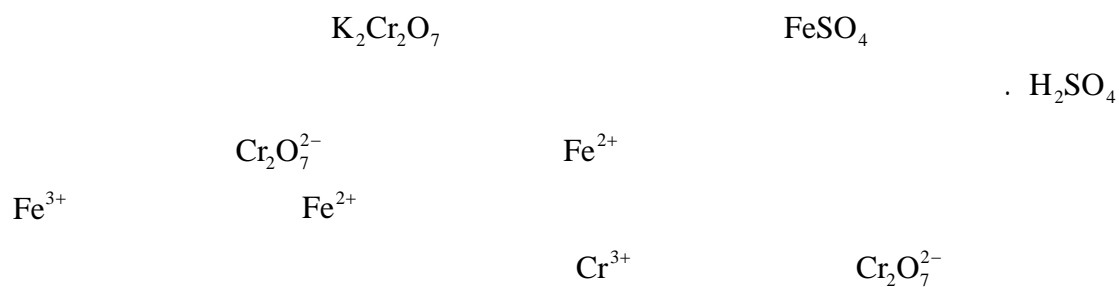
$\times 1$



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2



التجارب العملية

: **-1**

(4) -

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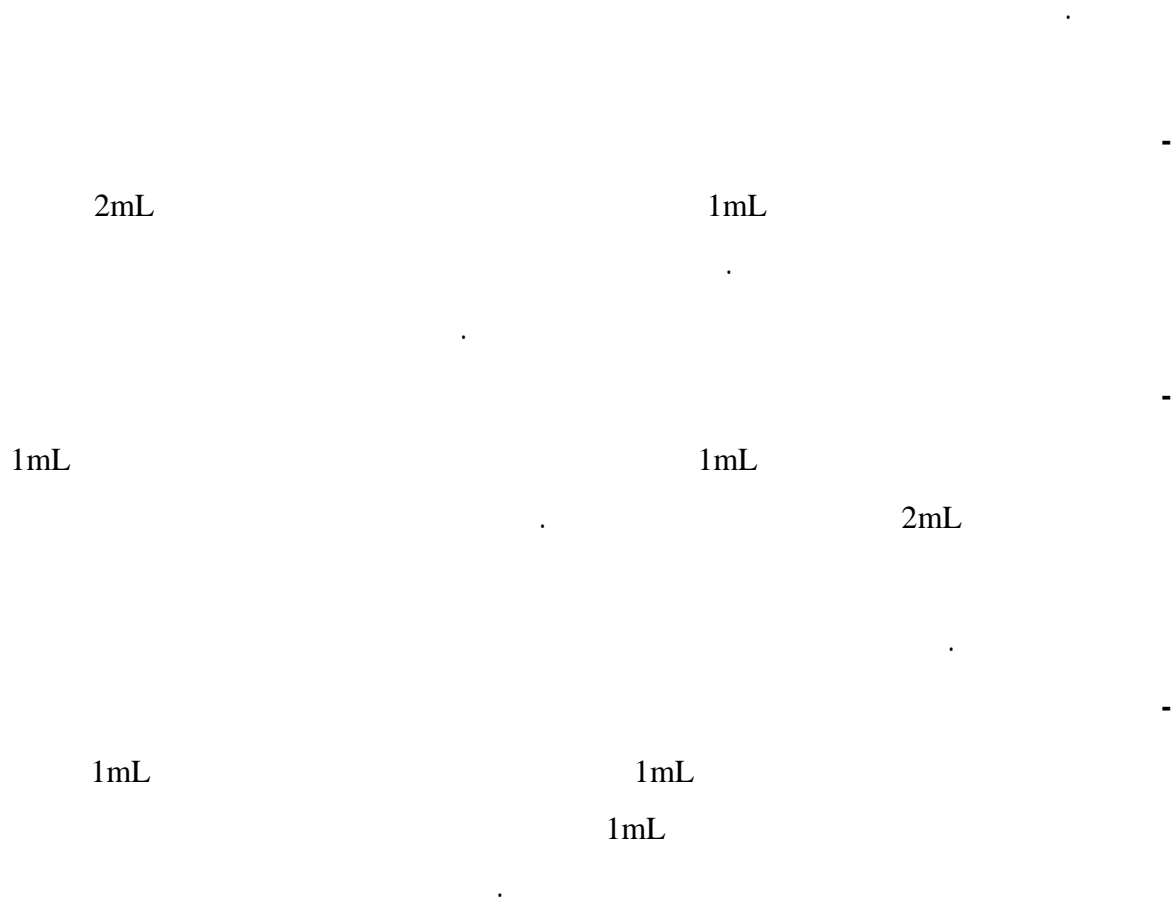
: **-2**

0.1N - 0.1N -

0.1N - 0.1N -

0.1N - 0.1N -

	0.1N	-	0.05N	-	
	0.1N	-	0.1N	-	
			:	-	
					-
1mL			1mL		
					-
			1mL		
)		
				(
			1mL		-
					-
1mL			1mL		
					-
1mL			1mL		
					-
1mL			1mL		



الفصل الثامن

التحليل النوعي

:

()

-I

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-

Hg_2^{2+}
HCl

Pb^{2+}

Ag^+

:

-

As^{5+}

Sn^{2+}

Sn^{4+}

Sb^{3+}

Sb^{5+}

As^{3+}

Cd^{2+}

Cu^{2+}

Bi^{3+}

Hg^{2+}

$(\text{S}^{2-}) \text{H}_2\text{S}$

:

-

Cr^{3+}

Al^{3+}

$\text{Fe}^{2+} \text{Fe}^{3+}$

:

-

Co^{2+}

Ni^{2+}

Zn^{2+}

Mn^{2+}

$(\text{S}^{2-}) \text{H}_2\text{S} \text{Na}_2\text{S}$

:

-

. Sr^{2+} Ba^{2+} Ca^{2+} :

.
:
-

. NH_4^+ K^+ Na^+

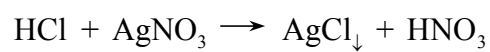
-1-9

Hg_2^{2+} Pb^{2+} Ag^+

-1-1-9

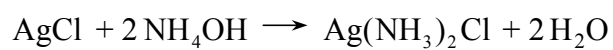
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() -

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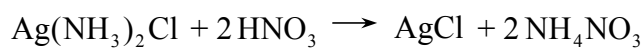


. $[\text{AgCl}_2]^-$

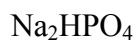
: AgCl



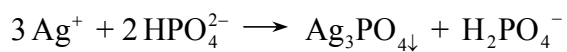
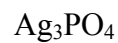
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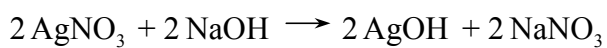


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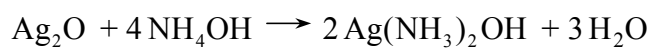
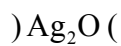
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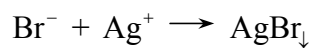


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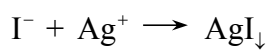
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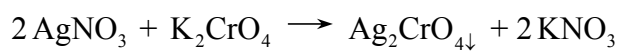
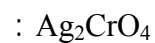


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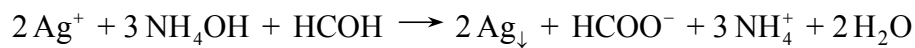
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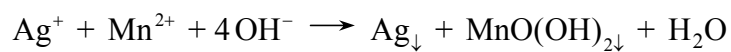
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(HCOH)

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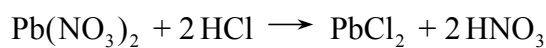
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-2-1-9

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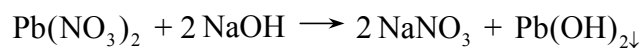
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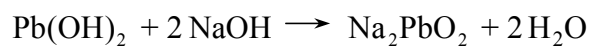
. PbCrO₄

PbCl₂

: Pb(OH)₂

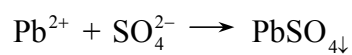


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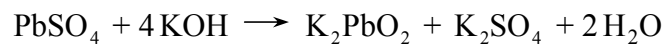
PbSO₄

:

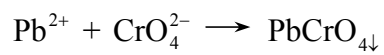


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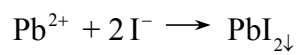
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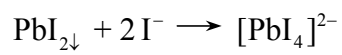
-

: PbI_2



KI

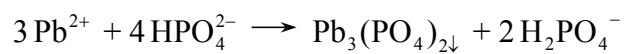
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Na_2HPO_4



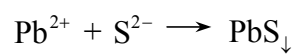
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S^{2-}

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PbS

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-3-1-9

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Hg_2Cl_2

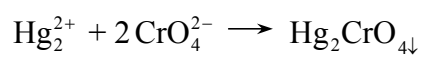
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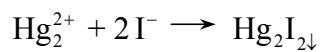
: Hg_2CrO_4



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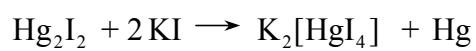


HgI_2

$\text{K}_2(\text{HgI}_4)$

Hg

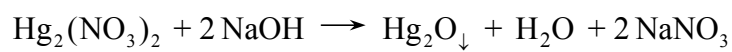
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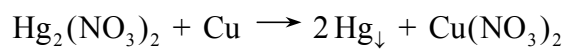
Hg_2O



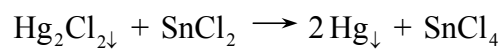
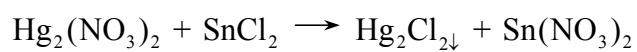
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-4-1-9

2mL **-1**

-2

1mL 2mL **-3**

KCN 2mL **-**

1mL 2mL **-4**

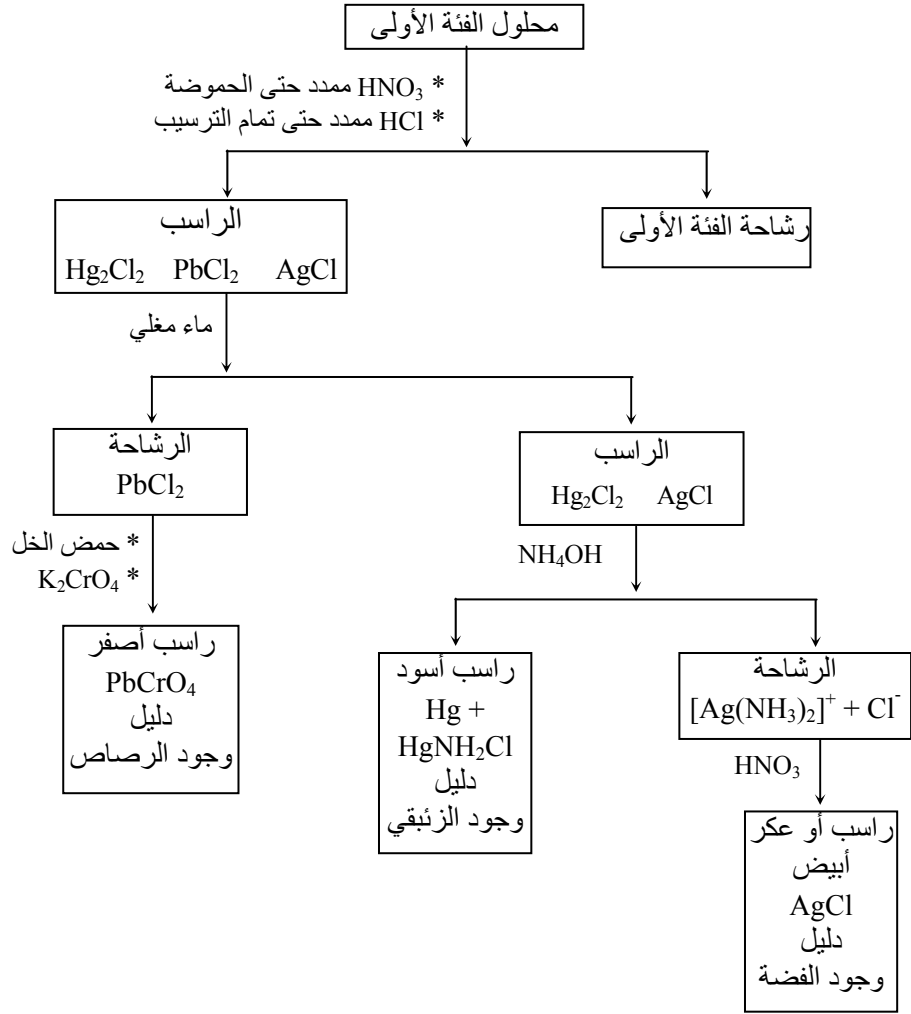
1mL 2mL **-5**

2mL 1mL **-6**

-5-1-9

		2mL	-1
.	.		
:			
.	.	:	-
.		:	-
.	.	:	-
		2mL	-2
.	.	.	
:			
.		:	-
.		:	-
		2mL	-3
.	.		
:			
.	.	:	-
.	.	:	-
2mL	2mL		-4
.	.	.	
:			
.	KI	:	-
.	.	:	-
.			
.	2mL		-5
.	.		
.	2mL		-6
.	.		
.	.		

			-6-1-9
		2mL	-1
		2mL	-2
	1mL	2mL	-3
		5mL	-4
		2mL	-5
			-7-1-9
			-1
			-2
		AgCl	-3



-2-9

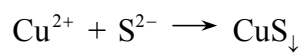


-1-2-9

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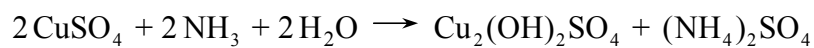
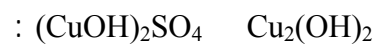
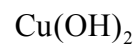
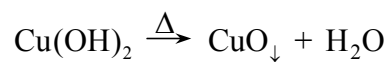
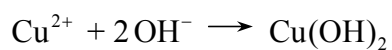
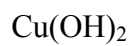
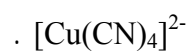
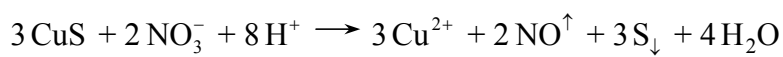
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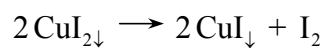
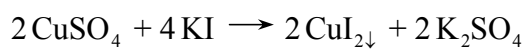
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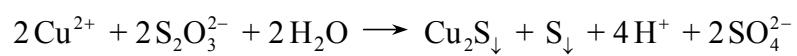
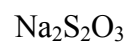
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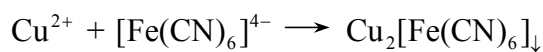




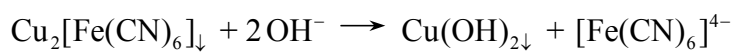
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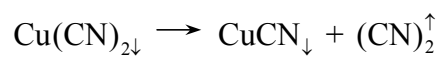
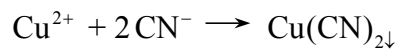
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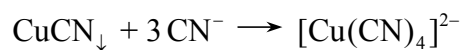
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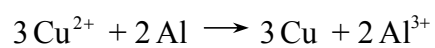
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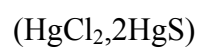
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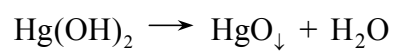
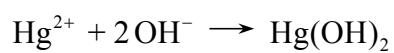
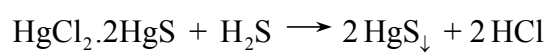
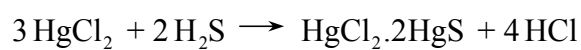
-2-2-9



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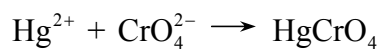


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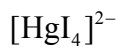
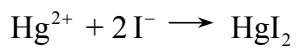




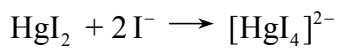
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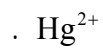
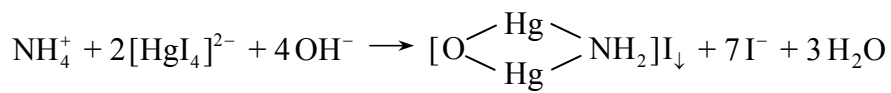


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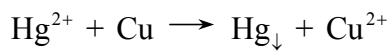
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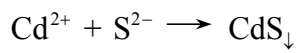
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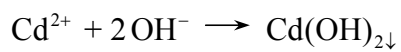


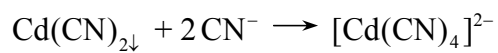
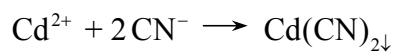
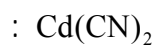
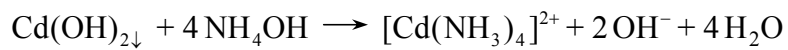
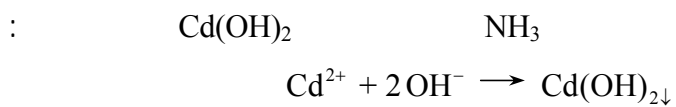
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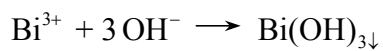
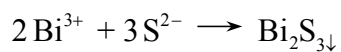
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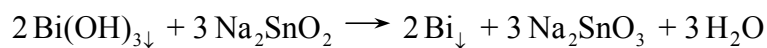
-4-2-9

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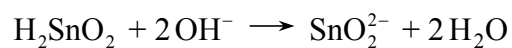
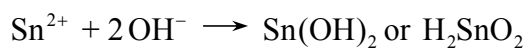




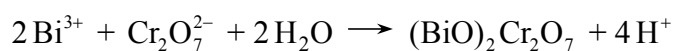
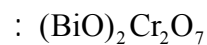
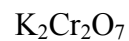
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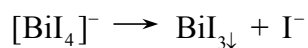
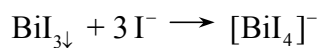
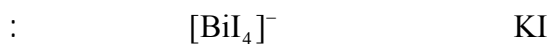
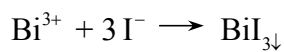


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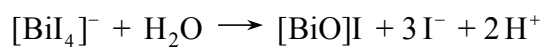


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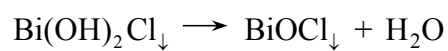
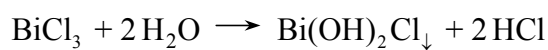
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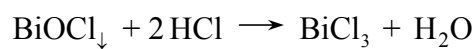
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-5-2-9

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2mL

2mL

2mL

2mL

2mL

-

NaOH

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-6-2-9

2mL

-1

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(

2mL

-2

2mL

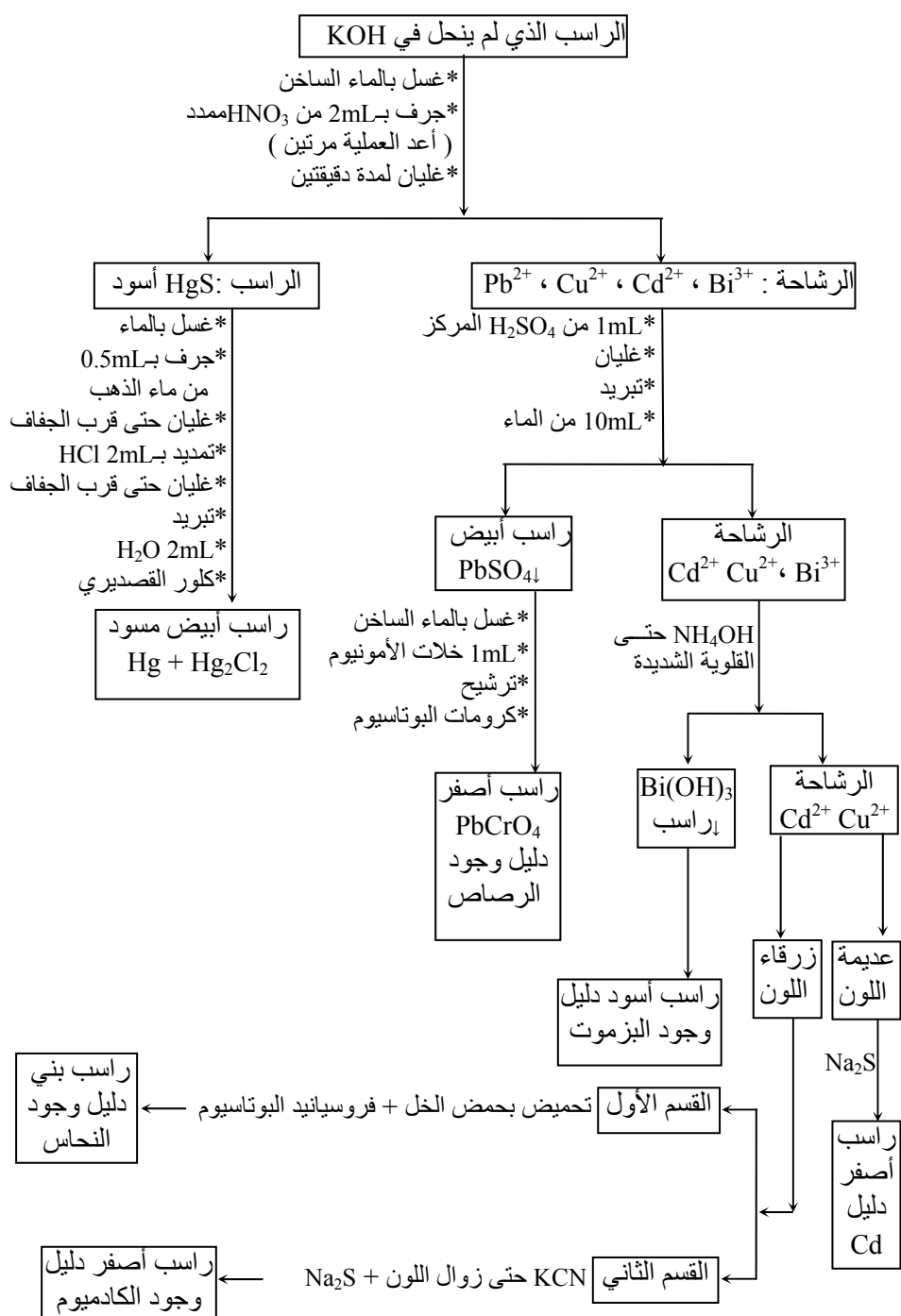
-3

-7-2-9

1mL

-1

	1mL		
		1mL	-2
			-3
			-8-2-9
0.5mL		1mL	-
		KCN	
			-9-2-9
		2mL	-1
		1mL	-2
		2mL	-
		2mL	-3
KI			
		2mL	-4



-3-9

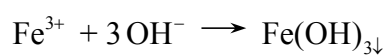
. Cr^{3+} Al^{3+} Fe^{2+} Fe^{3+} :

pH

Fe^{3+}

1-3-9

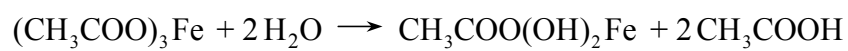
: $\text{Fe}(\text{OH})_3$



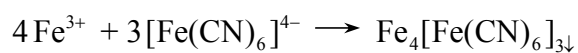
$\text{Fe}(\text{OH})_3$ ()

$(\text{CH}_3\text{COO})_3\text{Fe}$

. ()

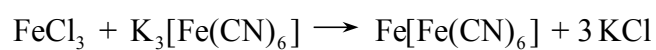


: Fe^{3+} $\text{K}_4[\text{Fe}(\text{CN})_6]$



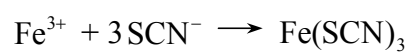
. $\text{Fe}(\text{OH})_3$

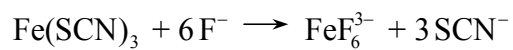
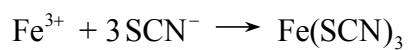
: $\text{Fe}[\text{Fe}(\text{CN})_6]$ Fe^{3+} $\text{K}_3[\text{Fe}(\text{CN})_6]$



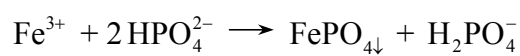
$\text{Fe}(\text{SCN})_3$ Fe^{3+}

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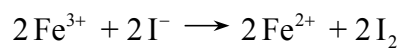
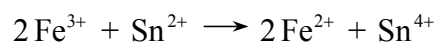
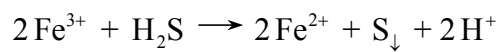
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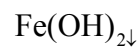
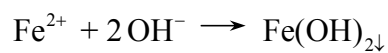
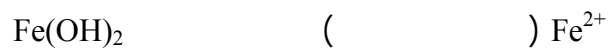
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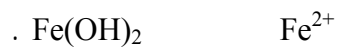
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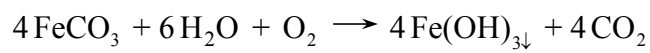
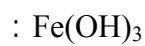
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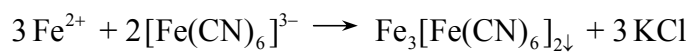
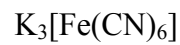


$$\cdot \text{P}_{\text{sp}} = 4.9 \times 10^{-16}$$

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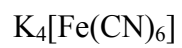


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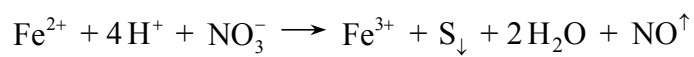
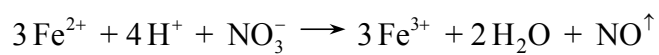
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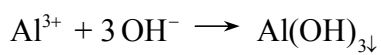
-3-3-9

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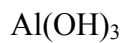
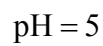
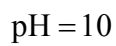
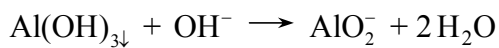
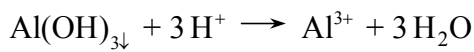
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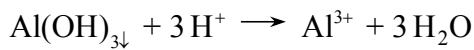
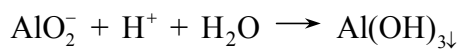
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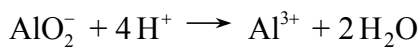
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: HCl



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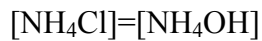


. NH_4Cl

. $\text{pH} = 5$

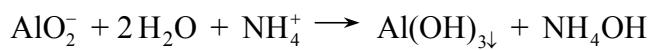
pH

pH



$\text{pH} = 9$

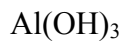
: Al(OH)_3



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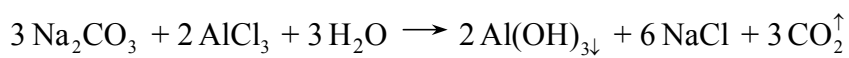


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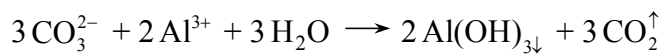
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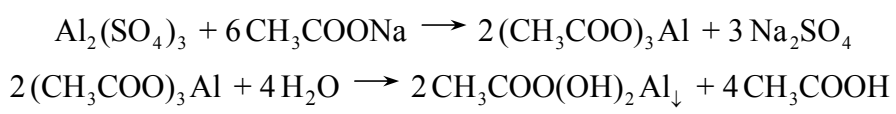


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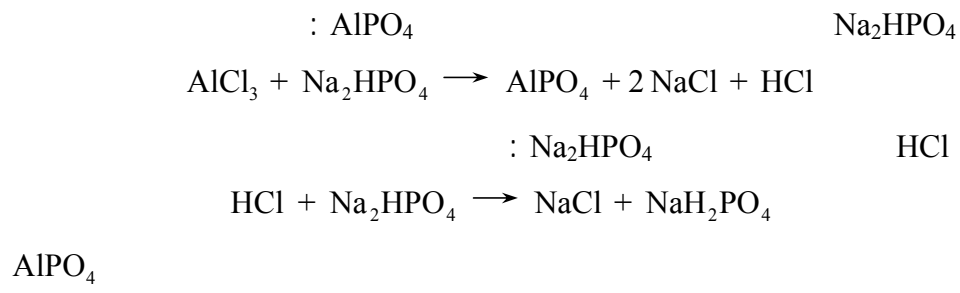
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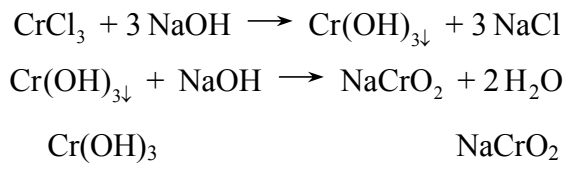
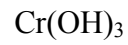


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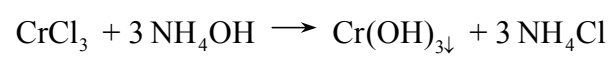
Cr³⁺ **-4-3-9**

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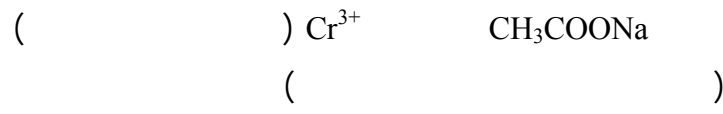
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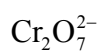
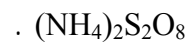
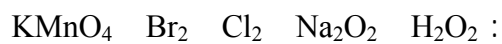
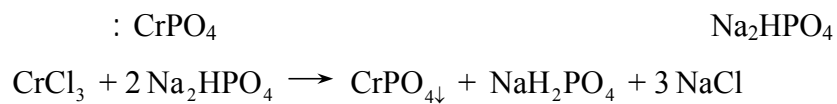


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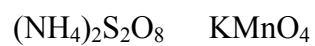
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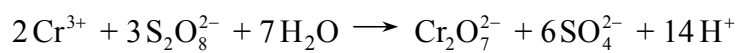


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-5-3-9

-

(1mL)

-

1mL

-

2mL

-6-3-9

-1

1mL

-2

1mL

-3

2mL Na_2HPO_4

-4

1mL

-7-3-9

-1

1mL

		2mL	-2
()	.	.
			-8-3-9
		1mL	-1
		.	.
		1mL	-2
.			
	.	.	
			-9-3-9
		1mL	-1
	.	.	.
1mL		: Al ³⁺	-2
	.	.	

Fe(C
سمين

ثاني

HCl* الممدد
* تحريك
يقسم إلى قسمين

KSCN
سيانيد
الاسيوم

لون
أحمر
دليل
وجود
الحديد

-4-9

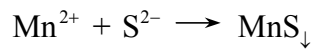
. Co^{2+} Ni^{2+} Zn^{2+} Mn^{2+} :
(S^{2-}) Na_2S

Mn^{2+}

-1-4-9

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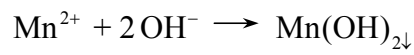
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: Mn(OH)_2

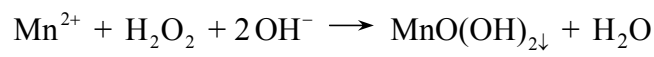


) H_2MnO_3 MnO(OH)_2

Mn^{2+}

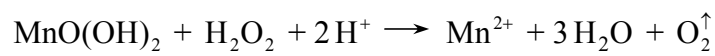
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Mn(OH)_2

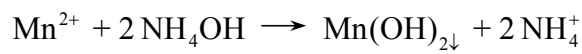
:



-

:

Mn^{2+}



) 10

pH

NH_4Cl

Mn^{2+}

. (

NH_4OH

Fe^{3+} Cr^{3+} Al^{3+}

NH_4OH

Fe^{3+} Cr^{3+} Al^{3+} Mn^{2+}

. NH_4Cl

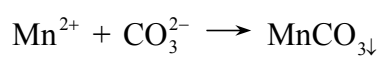
. MnO(OH)_2

Mn^{4+}

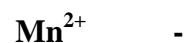
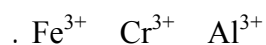
Mn^{2+}

-

MnCO_3



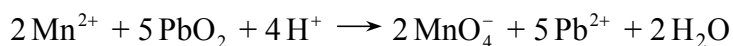
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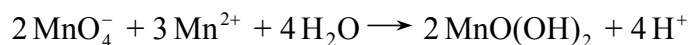
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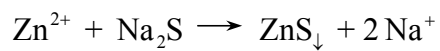
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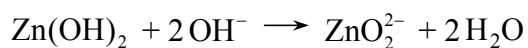
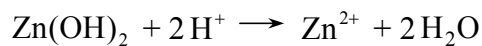
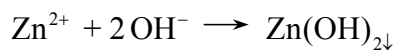
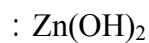
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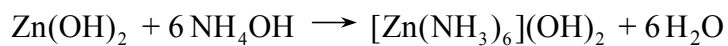
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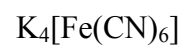
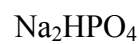
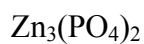


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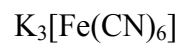
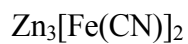
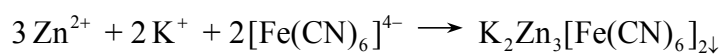
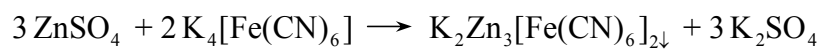


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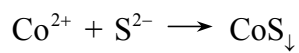
:



-3-4-9

()

: CoS



:



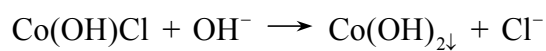
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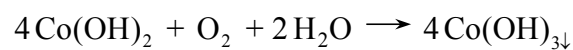
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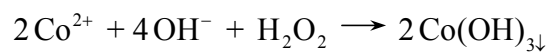
:



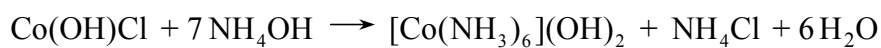
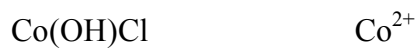
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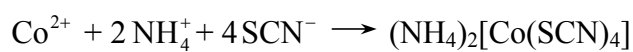
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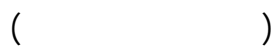
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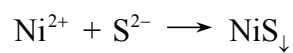
-4-4-9



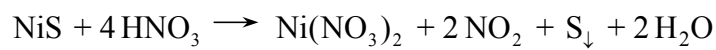
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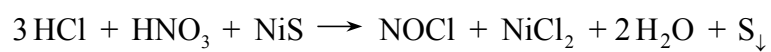
:



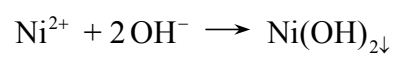
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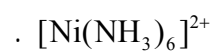
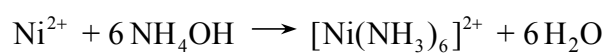
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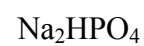
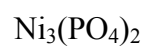
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-5-4-9

Na₂S

-

1mL

Na₂S

-

Ni²⁺ Zn²⁺ Mn²⁺

1mL

Co²⁺

-

-

1mL

-6-4-9

2mL

-

-7-4-9

1mL

-1

1mL

-2

-8-4-9

	1mL	-1
2mL	1mL	-2
		-9-4-9
	1mL	-1
	1mL	-2

NH_4
 Na_2S -

ZnS ، أبيض
 CoS أسود

بـ NH_4Cl
بـ HCl + تحريك
ين

NiS ، CoS : بـ

* ماء الذهب
* غليان حتى قرب الجفاف
* تبريد
* HCl + تسخين حتى الجفاف
* تبريد + تمديد بالماء

محلول
 Ni^{2+} ، Co^{2+}

القسم الثالث

القسم الثاني

* NH_4Cl
* NH_4OH
حتى القلوية
* ثاني ميثيل
غليوكسيم

* 2g من
ثيوسيانات
الأمونيوم
* 2mL من
الأسيتون
* خض
* تر قند

راسب
أحمر
دليل
وجود
النیکل

راسب
أزرق
دليل
وجود
الكوبالت

الفصل التاسع

التحليل الكمي الحجمي

-1-8

-

()

.

-

()

. ()

$$N.V = N'.V'$$

. : N

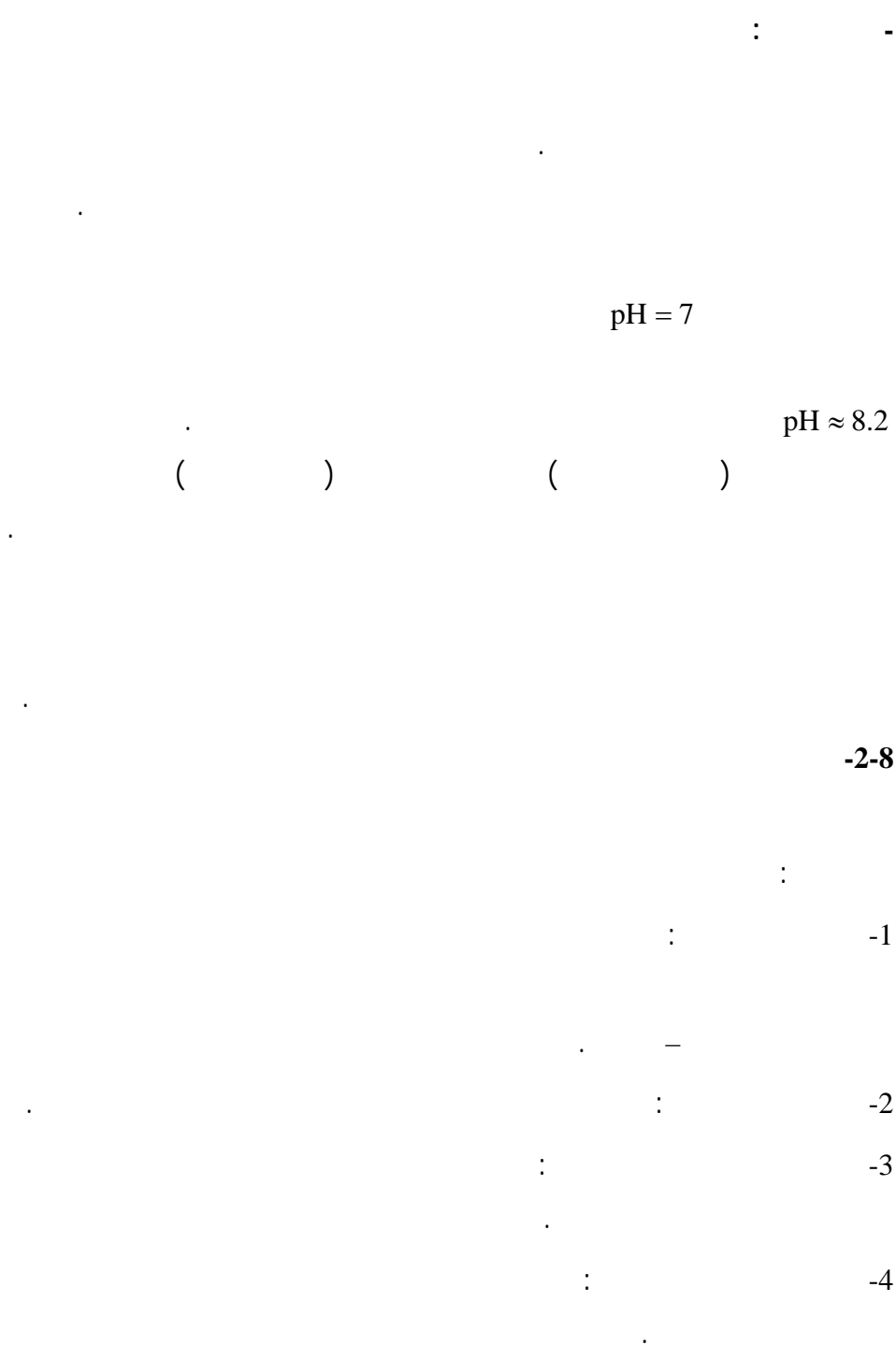
. () : V

. () : N'

. : V'

-

.



()

() -3-8

m

E

:

n

$$E = \frac{m(\text{g/mol})}{n(\text{eq/mol})}, \text{g/eq}$$

n

:

n

-

. H_3PO_4 H_2SO_4 HCl :

. 3 2 1

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{36.5}{1} = 36.5 \text{g/eq}$$

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{98}{2} = 49 \text{g/eq}$$

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{98}{3} = 32.67 \text{g/eq}$$

n

-

. $\text{Cr}(\text{OH})_3$ $\text{Mg}(\text{OH})_2$ NaOH :

. 3 2 1

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{40}{1} = 40 \text{g/eq}$$

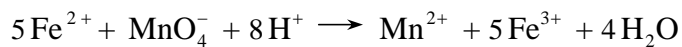
$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{58}{2} = 28 \text{ g/eq}$$

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{103}{3} = 34.33 \text{ g/eq}$$

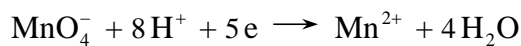
n -

.

:



:



.

:

$$E = \frac{158}{5} = 31.6 \text{ g/eq}$$

. (×) n -



. 3 2 1

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{58.5}{1} = 58.5 \text{ g/eq}$$

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{95}{2} = 47.5 \text{ g/eq}$$

$$= \frac{m(\text{g/mol})}{n(\text{eq/mol})} = \frac{419}{3} = 139.67 \text{ g/eq}$$

-4-8

. — — :

-1-4-8

() M -

M

: (mol/L)

$$M = \frac{C(g/L)}{m(g/mol)}, \text{mol/L}$$

C :

. (g/mol) m (g/L)

4g

500mL

. (m = 40g/mol)

8g/L 500mL 4g :

:

$$M = \frac{C}{m} = \frac{8g/L}{40g/mol} = 0.2 \text{ mol/L}$$

:

$$N = n \cdot M = 1 \times 0.2 = 0.2 \text{ eq - g/L}$$

$$N = \frac{C g/L}{E(g/eq)} = \frac{8}{40/1} = 0.2 \text{ eq - g/L} \quad ;$$

(%V) -

. 100mL

$$(m = 40\text{ g/mol})$$

$$. 0.4\text{mol/L}$$

$$: C = m M \quad :$$

$$C = 40(\text{g/mol}) \times 0.4(\text{mol/L}) = 16\text{ g/L}$$

$$. 1.6\%$$

$$C \quad -$$

$$C \quad \text{g}$$

$$\mu\text{g/mL} \quad \text{mg/L} \quad . \text{ g/L}$$

.

$$C = N.E \quad \text{or} \quad C = M.N$$

-

$$(\text{eq.g/L})$$

:

$$N = \frac{C(\text{g/L})}{E(\text{g/eq})}, \text{eq/L}$$

$$C :$$

$$. \quad E . (\text{g/L})$$

:

$$N = n M$$

-

-2-4-8

$$(\quad) L \quad -$$

$$. \quad 1000\text{g}$$

$$: \quad \text{mol/Kg}$$

$$L = \frac{P(g/Kg)}{m(g/mol)}, mol/Kg$$

m 1Kg P :

.

(%P) -

100g

10%

AgNO₃ 2g . 10g

. 20g

. P = 10%

(x_i) -

()

.

n₂

n₁

:

$$x_1 = \frac{n_1}{n_1 + n_2}$$

$$x_2 = \frac{n_2}{n_1 + n_2}$$

: ()

$$x_1 + x_2 + x_3 + ... = 1$$

NaOH

.

10%P

NaOH 100g :

: 90 g 10g

$$\text{NaOH} \quad n_1 = \frac{100}{40} = 0.25 \text{ mol}$$

$$\text{H}_2\text{O} \quad n_2 = \frac{90}{18} = 5 \text{ mol}$$

$$\text{NaOH} \quad x_1 = \frac{n_1}{n_1 + n_2} = \frac{0.25}{0.25 + 5} = 0.048$$

$$\text{H}_2\text{O} \quad x_2 = \frac{n_2}{n_1 + n_2} = \frac{5}{0.25 + 5} = 0.952$$

-5-8

8N

. 2N

(2N)

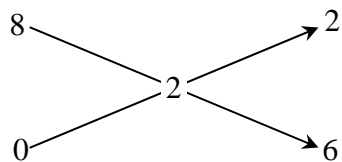
•

•

(ON)

(8N)

:



(2 : 6) 8N

8N

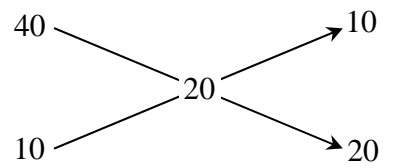
250mL

. 750mL

40% V

. 20% V

10% V

$$\vdots$$


. 1 : 2 (10 : 20)

10% V

. 40% V

-6-8

•

•

•

•

•

•

:

•

-1

•

-2

•

-3

... ..

-

.

:

. 10%

-

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-

.

-

.

-

I المعايرة بالتعديل

1-	:	-
-1		
()	HCl	
:		
	$\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$	
OH^-		
pH		
pH		
	$\text{pH} = 7$	
-2		
-		
-		
-3		
-		
-	0.1N	
-		

-3

10mL

-

)

-

.(

-

. V₁

-

-

$$\bar{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

:

-a

:

NaOH

(HCl) N \bar{V} = N' V' (NaOH)

$$0.1 \times \bar{V} = N' 10$$

$$N' = \frac{0.1 \bar{V}}{10} = 0.01 \times \bar{V} \text{ (eq.g/L)}$$

:

-b

$$M = \frac{N'}{n} = \frac{0.01 \times \bar{V}}{1} = 0.01 \times \bar{V} \text{ (mol/L)}$$

:

-c

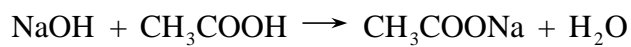
$$C = N' \times E = 0.01 \times \bar{V} \times \frac{40}{1} = 0.40 \times \bar{V} \text{ (g/L)}$$

:
-

-1

() NaOH

 :



pH
NaOH

: ()

 $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COOH} + \text{OH}^-$

pH > 7
pH

.

-2

-
-

-
-

-3

. 0.1N
-

.
-

.
-

-3

10mL

-

(0.1N

)

-

-

V_1

-

-

$$\bar{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

:

-a

:

CH_3COOH

(NaOH) $N \bar{V} = N' V'$ (CH_3COOH)

$$0.1 \times \bar{V} = N' 10$$

$$N' = \frac{0.1 \bar{V}}{10} = 0.01 \times \bar{V} (\text{eq.g/L})$$

:

-b

$$M = \frac{N'}{n} = \frac{0.01 \times \bar{V}}{1} = 0.01 \times \bar{V} (\text{mol/L})$$

:

-c

$$C = N' \times E = 0.01 \times \bar{V} \times \frac{60}{1} = 0.60 \times \bar{V} (\text{g/L})$$

: -

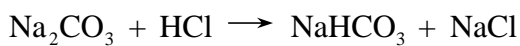
-1

() HCl
:

()

:

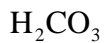
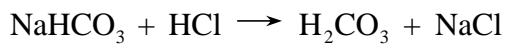
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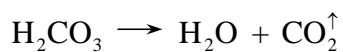
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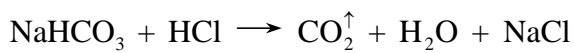
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:



:



()

.

.	-2
-	-
-	-
.	-3
. 0.1N	-
.	-
.	-
.	-
.	-3
10mL	-
.	-
(0.1N)	-
.	-
.	-
. V _x	-
.	-
. ()	-
.	-

$$\cdot V_y$$

:

-

$$V_l = V_x + V_y$$

-

$$\bar{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

:

-a

:



$$(\text{HCl}) \quad N \quad \bar{V} = N' V' \quad (\text{Na}_2\text{CO}_3)$$

$$0.1 \times \bar{V} = N' 10$$

$$N' = \frac{0.1 \bar{V}}{10} = 0.01 \times \bar{V} (\text{eq.g/L})$$

HCl

\bar{V} :

.

:

-b

$$M = \frac{N'}{n} = \frac{0.01 \times \bar{V}}{2} = 5 \times 10^{-3} \times \bar{V} (\text{mol/L})$$

$$\cdot n = 2$$

:

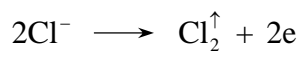
-c

$$C = N' \times E = 5 \times 10^{-3} \times \bar{V} \times \frac{106}{2}$$

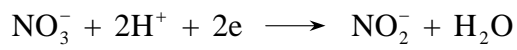
$$C = 0.265 \times \bar{V} (\text{g/L})$$

II معايرات الأكسدة والإرجاع

:



:



()

I^{-}

-3

10mL
-
6N 5mL

() -

) -

(

. V₁ -

-

$$\bar{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

: -a

(KMnO₄) N $\bar{V} = N'V'$ (H₂O₂)

$$N' = \frac{0.1 \bar{V}}{10} = 0.01 \times \bar{V} (\text{eq.g/L})$$

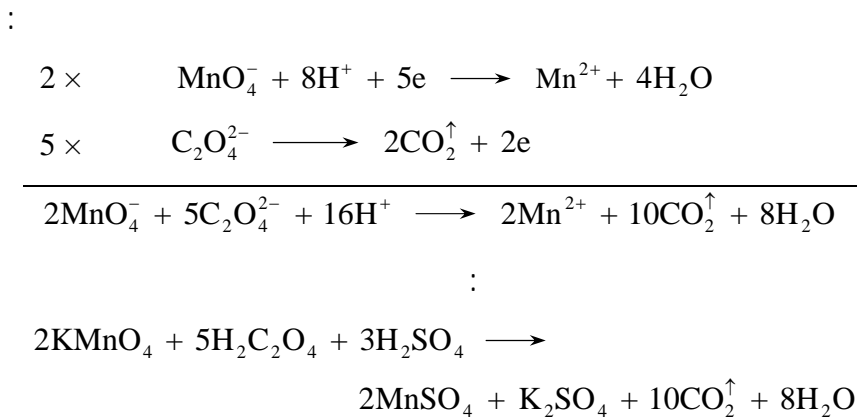
: -b

$$M = \frac{N'}{n} = \frac{0.01 \times \bar{V}}{2} = 5 \times 10^{-3} \times \bar{V} (\text{mol/L})$$

: -c

$$C = N' \times E = 0.01 \times \bar{V} \times \frac{34}{2} = 0.17 (\text{g/L})$$

: -
-1



.
-2
-
-
-3
.
-
0.1N
-
6N
-

-3

10mL
-
6N 5mL

() -

) -

(

. V₁ -

-

$$\bar{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

: -a

(KMnO₄) N $\bar{V} = N'V'$ (H₂C₂O₄)

$$N' = \frac{0.1 \bar{V}}{10} = 0.01 \times \bar{V} (\text{eq.g/L})$$

: -b

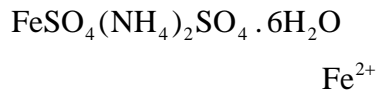
$$M = \frac{N'}{n} = \frac{0.01 \times \bar{V}}{2} = 5 \times 10^{-3} \times \bar{V} (\text{mol/L})$$

: -c

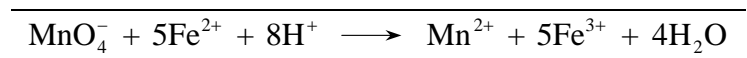
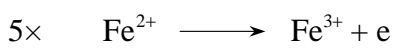
$$C = N' \times E = 0.01 \times \bar{V} \times \frac{90}{2} = 0.45 (\text{g/L})$$

: -

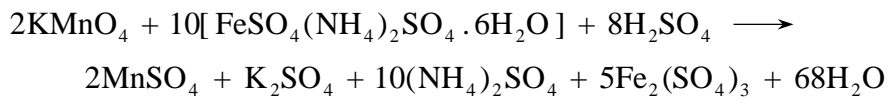
-1



:



:



.

-2

-

-

-

-

-3

.

-

. 0.1N

-

. 6N

-

-3

10mL
-
6N 5mL

() -

) -

(

. V₁ -

-

$$\bar{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

: -a

$$(\text{KMnO}_4) \quad N \quad \bar{V} = N' V' \quad (\text{Fe}^{2+})$$

$$N' = \frac{0.1 \bar{V}}{10} = 0.01 \times \bar{V} (\text{eq.g/L})$$

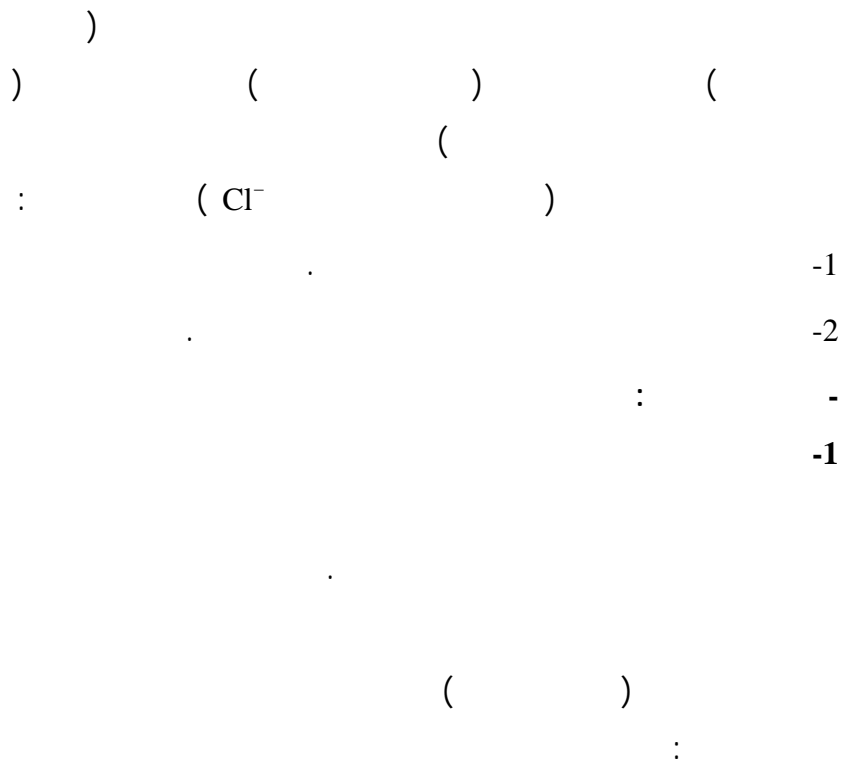
: -b

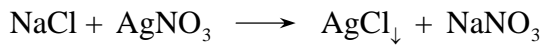
$$M = \frac{N'}{n} = \frac{0.01 \times \bar{V}}{1} = 0.01 \times \bar{V} (\text{mol/L})$$

: -c

$$C = N' \times E = 0.01 \times \bar{V} \times \frac{392}{1} = 3.92 (\text{g/L})$$

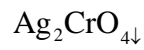
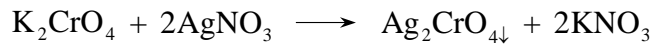
III معايرات الترسيب





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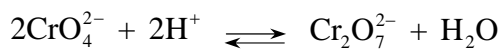
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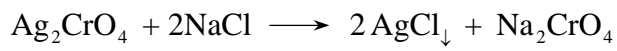
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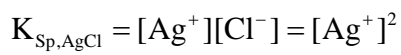
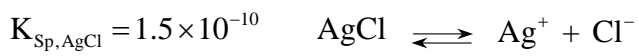
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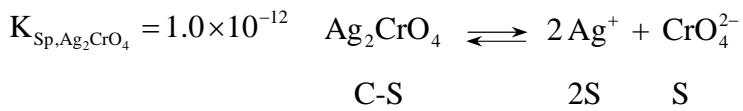
:



:



$$S = [Ag^+] = \sqrt{K_{Sp,AgCl}} = \sqrt{1.2 \times 10^{-10}} \approx 10^{-5} \text{ mol/L}$$



$$K_{Sp,Ag_2CrO_4} = [Ag^+]^2 [CrO_4^{2-}]$$

$$K_{Sp,Ag_2CrO_4} = (2S)^2 (S) = 4S^3$$

$$S = [CrO_4^{2-}] = \sqrt[3]{\frac{K_{Sp,Ag_2CrO_4}}{4}} = \sqrt[3]{\frac{10^{-12}}{4}} \approx 0.28 \times 10^{-3} \text{ mol/L}$$

-2

-

-

-

-

-3

.

-

0.01N

-

5%

-

-3

10mL

-

.

()

-

.

()

. V₁

$$\overline{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

: -a

(AgNO₃) N \overline{V} = N' V' NaCl

$$N' = \frac{0.01 \overline{V}}{10} = 1 \times 10^{-3} \times \overline{V} (\text{eq.g/L})$$

: -b

$$M = \frac{N'}{n} = \frac{1 \times 10^{-3} \times \overline{V}}{1} = 1 \times 10^{-3} \times \overline{V} (\text{mol/L})$$

: -c

$$C = N' \times E = 1 \times 10^{-3} \times \overline{V} \times \frac{58.5}{1} = 0.0585 (\text{g/L})$$

: ()

$$C = 1 \times 10^{-3} \times \overline{V} \times 35.5 = 0.0355 (\text{g/L})$$

$$= 35.5 \text{ mg/L}$$

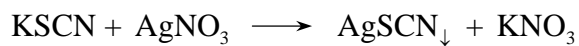
50mL

☆

: -
-1

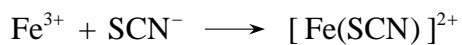
. KSCN

:



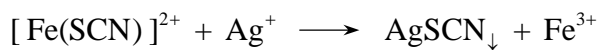
. $\text{Fe}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 24\text{H}_2\text{O}$

: $[\text{Fe}(\text{SCN})]^{2+}$



:

AgSCN



SCN^{-}

$[\text{Fe}(\text{SCN})]^{2+}$

-2

-

-

-3

0.01N

4N

-3

10mL

()

AgSCN

[Fe(SCN)]²⁺

V₁

$$\bar{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

:

-a

(KSCN) N \bar{V} = N' V' AgNO₃

$$N' = \frac{0.01 \bar{V}}{10} = 1 \times 10^{-3} \times \bar{V} \text{ (eq.g/L)}$$

:

-b

$$M = \frac{N'}{n} = \frac{1 \times 10^{-3} \times \bar{V}}{1} = 1 \times 10^{-3} \times \bar{V} \text{ (mol/L)}$$

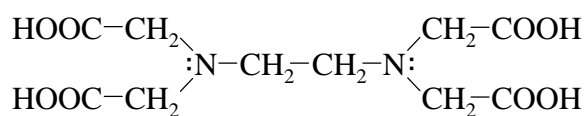
$$C = M \times m = 1 \times 10^{-3} \times \bar{V} \times 108 = 0.108 \text{ (g/L) } :$$

-c

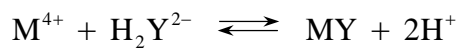
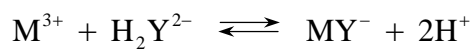
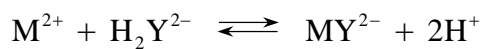
IV المعاييرة بتشكيل المعقدات

EDTA

:



: (2+, 3+, 4+)



EDTA

EDTA

()

()

:

-1



-2

-

-1

:



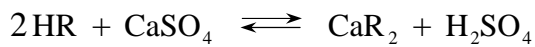
-2



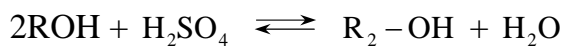
HR

ROH

: ()

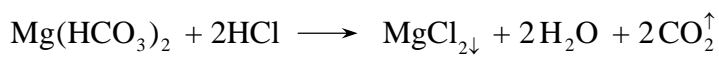
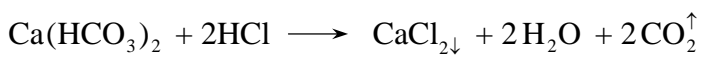


:



. SO_4^{2-} Ca^{2+}
 : -
 -1

:



4 pH

. (3.3-4.1)

-2

-

-

-

-

-3

. 0.1N

-

.

-

-3

100mL

-

()

-

-

. V₁

-

-

$$\overline{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

:

-a

$$(HCl) \quad N \quad \overline{V} = N' V' \quad Ca, Mg(HCO_3)_2$$

$$0.1 \times \overline{V} = N' 100$$

$$N' = \frac{0.1 \overline{V}}{100} = 1 \times 10^{-3} \times \overline{V} \text{ (eq.g/L)}$$

:

-b

$$M = \frac{N'}{n} = \frac{1 \times 10^{-3} \times \overline{V}}{2} = 5 \times 10^{-4} \times \overline{V} \text{ (mol/L)}$$

10⁻⁴

:

-c

:

$$\frac{5 \times 10^{-4} \times \overline{V}}{10^{-4}} = 5 \overline{V}$$

: -

-1

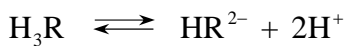
T

EDTA

H₃R

:

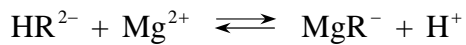
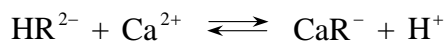
HR²⁻



T

MgR⁻ CaR⁻

:



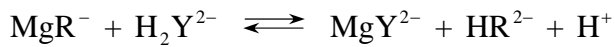
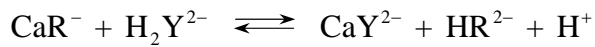
CaR⁻

EDTA

EDTA

MgR⁻

:



.

-2

-

-

-

-

-3

. 0.02N EDTA -

. T -

. pH = 9.5 -

-3

100mL -

10mL T

)

pH = 9.5

. (

EDTA -

.

-

)

(

)

(

.

. V₁ -

-

.

$$\overline{V} = \frac{V_1 + V_2 + V_3}{3}$$

-4

: -a

(EDTA) $N \bar{V} = N' V'$ Ca,Mg

$$0.02 \times \bar{V} = N' 100$$

$$N' = \frac{0.02 \bar{V}}{100} = 2 \times 10^{-4} \times \bar{V} \text{ (eq.g / L)}$$

: -b

$$M = \frac{N'}{n}$$

$$M = \frac{2 \times 10^{-4} \times \bar{V}}{2} = 1 \times 10^{-4} \times \bar{V} \text{ (mol / L)}$$

n=2 :

.

10^{-4}

1

\bar{V}

. 0.02N

EDTA

فهرس

5

11

الفصل الأول : أساسيات العمل المخبري

13

-1-1

15

-2-1

16

-3-1

17

-4-1

23

-5-1

24

-6-1

24

-1-6-1

24

-2-6-1

25

-3-6-1

26

-7-1

26

-1-7-1

26

2-7-1

27

3-7-1

الفصل الثاني : pH المحاليل والمحاليل الواقية

29

pH

-1-2

30

pH

-2-2

32

()

pH -3-2

32

()

pH -4-2

33 () pH -5-2

33 () pH -6-2

34 -7-2

34 -1-7-2

35 -2-7-2

36

الفصل الثالث : حلمة الأملاح

39 -1-3

39 -1-1-3

40 -2-1-3

40 -3-1-3

41 -2-1

42

الفصل الرابع : مبدأ لوشاتوليه والتوازن الكيميائي

45 -1-4

46 -2-4

46 -3-4

47 4-4

48

الفصل الخامس : التوازن في الجمل غير المتجانسة

51 -1-5

53

الفصل السادس : قانون لافوازييه ومصونية المادة

57 -1-6

58

58 () :

58 () :

59 () :

59 () :

59 () :

59 () :

الفصل السابع : الأكسدة والإرجاع

61 -1-7

63 -2-7

64 -1-2-7

65 -2-2-7

66

الفصل الثامن : التحليل النوعي

69 () -I

71 -1-9

71 -1-1-9

73 -2-1-9

75 -3-1-9

77

77 -4-1-9

78 -5-1-9

79 -6-1-9

80		-7-1-9
81		
82		-2-9
82		-1-2-9
85		-2-2-9
86		-3-2-9
88		-4-2-9
90		
90		-5-2-9
90		-6-2-9
91		-7-2-9
91		-8-2-9
92		-9-2-9
93		
94		-3-9
94	Fe^{3+}	1-3-9
96	Fe^{2+}	-2-3-9
98	Al^{3+}	-3-3-9
100	Cr^{3+}	-4-3-9
102		
102		-5-3-9
102		-6-3-9
103		-7-3-9

103		-8-3-9
103		-9-3-9
104		
105		-4-9
105	Mn^{2+}	-1-4-9
107	Zn^{2+}	-2-4-9
108	Co^{2+}	-3-4-9
110	Ni^{2+}	-4-4-9
112		
112		-5-4-9
112		-6-4-9
113		-7-4-9
113		-8-4-9
113		-9-4-9
114		
الفصل التاسع : التحليل الكمي الحجمي		
115		-1-8
116		-2-8
117	()	-3-8
119		-4-8
119	—	-1-4-8
120	—	-2-4-8
122		-5-8

123		-6-8
125		
125		I
125	:	-
127	:	-
129	:	-
132		II
133	:	-
135	:	-
137	:	-
139		III
139	:	-
143	:	-
145		IV
147	:	-
149	:	-
153		
165		
177		