6XJJHVWHG $QVZHUV

9&(&KHPLVWU\ 7U<LHDDU ([DP 8QLWV

6(&7,21 $ ± 0XOWLSOH &KRLFH $QVZHUV

4 & 7KH VHPL VWUXFWXUDO IRUPXOD RI VTXDOHQH LV

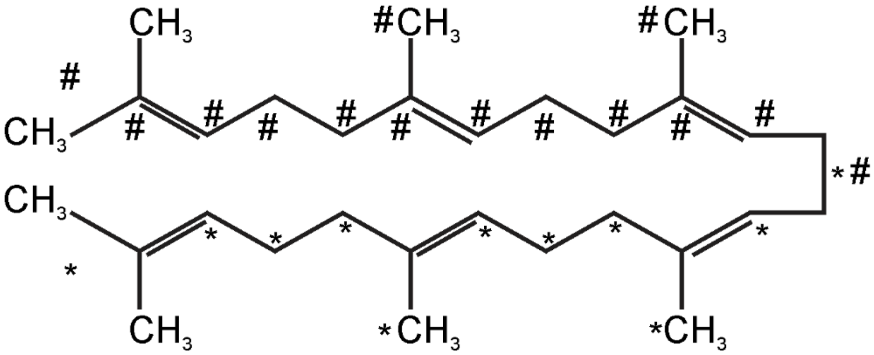
&+ & &+&+& &+& &+ &+&+&+& &+ &+&+

|

&+ & &+&+& &+& &+ &+&+&+& &+ &+&+

7KH DUH QR & DWRPV ERQGHG WR D WRWDO RI WKUHH RWKHU FDUERQV

6TXDOHQH PROHFXOH DVVHPEOHV WR VKRZ WKH VNHOHWDO



6TXDOHQH PROHFXOH KDV HLJKW FDUERQ DWRPV LQGLFDWHG E\ RQ WKH VNHOHWDO VWUXFWXUH

6TXDOHQH PROHFXOH KDV HOHYHQ FDUERQ DWRPV LQGLFDWHG E\ RQ WKH VNHOHWDO VWUXFWXUH

4 % *n* &+ 2 J J PRO PRO

(QHUJ\ UHOHDVHG IURP FRPEXVWLRQ RI FRPSRXQG N- PRO N-

'7 N- N- .

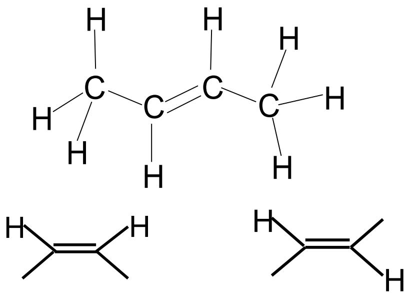
. q& WHPSHUDWXUH FKDQJHV .DUH WKH V

,QLWLDO WHPSHUDWXUH ± q&

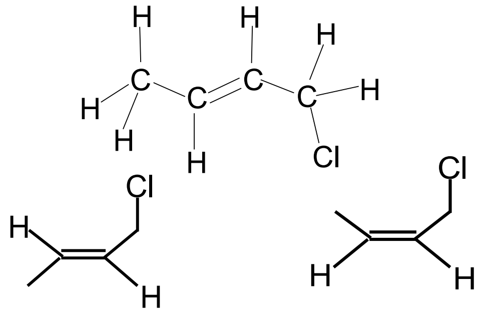
4 & 7KH LQGXFHG ILW PRGHO RI HQ]\PH DFWLRQ VXJJHVWV WKDW WKH D VXEVWUDWH UHDFWDQW FDXVHV FKDQJHV LQ WKH VKDSH FRPSOHPHQWDU\ WR WKDW RI WKH VXEVWUDWH IRU UHDFWLRQ WR RFFXU

4 '

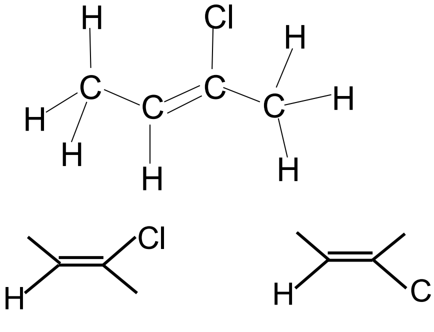
%XW HQH



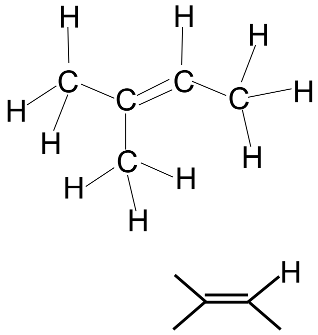
FKORUREXW HQ



FKORUREXW HQH



PHWK\OEXW HQH



4 $ (QHUJ\ UHOHDVHG GXULQJ FRPEXVWLRQ &RPEXVWLRQ - J

× -

N-

n K\GURFDUERQ EXUQW N- N- PRO

PRO

M K\GURFDUERQ *m* ±

J PRO

5HODWLYH PROHFXODU PDVV

4 & 7KH NH\ SLHFH RI LQIRUPDWLRQ LV WKH GLUHFWLRQ RI PRYHPHQW RI

,Q DOO HOHFWURFKHPLFDO FHOOV HOHFWURQV IORZ IURP WKH DQRGH

FHOOV QHJDWLYH HOHFWURGH

,Q DOO FHOOV R[LGDWLRQ RFFXUV DW WKH DQRGH

< V KDOI FHOO LV < V

7KH KDOI HTXDWLRQ DW WKH FDWKRGH LV < V

4 $ 7KH DPLQR DFLGV REVHUYHG LQ WKH SURWHLQ

QLWURJHQ DWRPV PROHFXOH VWUXFWXUHV I

Chemistry Data Book (Table 17) VXJJHVW QLQH

3URSRUWLRQV *m* 1\ *M* PDVV RI 1DFLG @ î

$UJLQLQH î

$VSDUDJLQH ± î

+LVWLGLQH ± î

/\VLQH ± î

4 ' $FFRUGLQJ WR HOHFWURFKHPLFDO VHULHV LQ Table 2 of the Chemistry Data Book

Eq JJ 9

Eq 3E3E 9

E JJ 3EE ± 9

$FFRUGLQJ WR WKH WKH FRQFHQWUDWLRQ ZH FDQ GHGXFH

E JJ < 9

6LQFH Eq JJ 9 Eq < WKHQ PXVW EH HLWKHU

ZKLFK ZRXOG SODFH LW DERYH RU EHORZ WKH

± 9

Eq < < Eq JJ E±FHOO ± 9

6R H[SDQG WKH HOHFWURFKHPLFDO VHULHV WR

Eq JJ 9

Eq 3E3E 9

Eq < < 9

Eq 3E DT 3E VDT < V ± 9

E 7ODT 7O VDT < V ± 9

Eq 7O7O LV HLWKHU PRUH RU L H OHVV 9 WKDQ

7KH ODWWHU LV XQOLNHO\ VLQFH LW ZRXOG SODF

6R Eq 7O7O

(OHFWURFKHPLFDO VHULHV EHFRPHV

Eq JJ 9

Eq 3E3E 9

Eq 7O7O 9

Eq < < 9

6WURQJHVW UHGXFWDQW LV <

4 % c HWKDQRO LQ PL[WXUH P P 9

c HWKDQRO LQ RULJLQDO PL[WXUH î

P 9

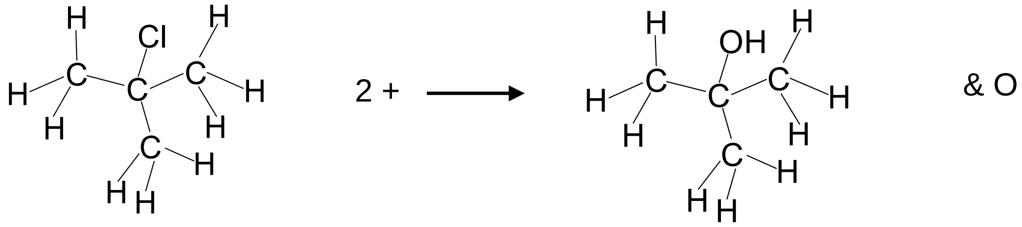
J LQ PRO

m &+&+2+ LQ P/ J J PRO

PRO

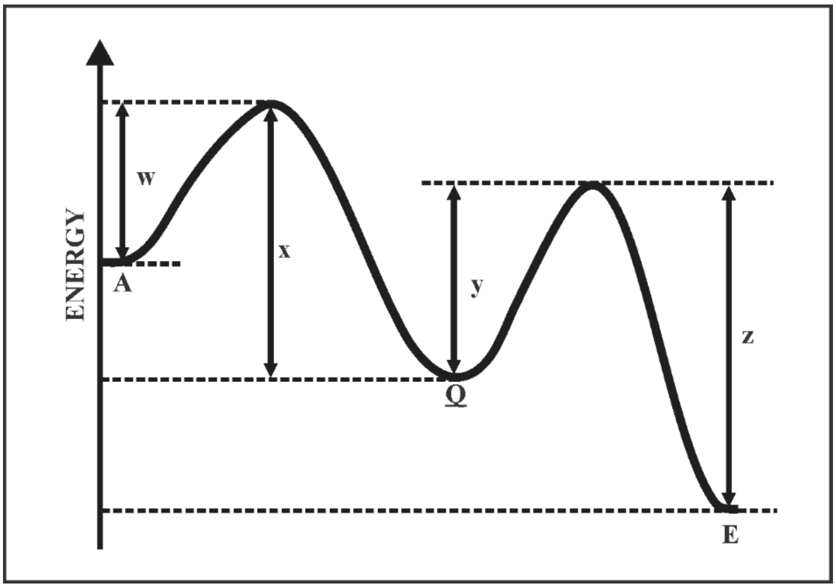
c &+&+2+ PRO /

4 $,Q 1D2+ DT FKORURPHWK\OSURSDUQHSZLQOO OROEH FR


H
Cl
H
H
C
C
C
H
H
H
C
H
H
H
2+
H
OH
H
H
C
C
C
H
H
H
C
H
H
H
&O

$V WKH@>2+ HFUHDVHV GXHSWRZLWKOKH GUHHFDUFHWDLVRHQ WKH

4 % &RQVLGHU WKH WZR FRQYHUVLRQ RI $ WR (



(QHUJ\ FKDQJH $ 4 [± Z

(QHUJ\ FKDQJH 4 ( ] ± \

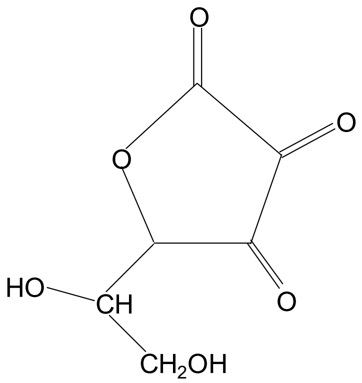
7RWDO HQHUJ\ FKDQJH $ ( ] \

[ ] ± Z ± \

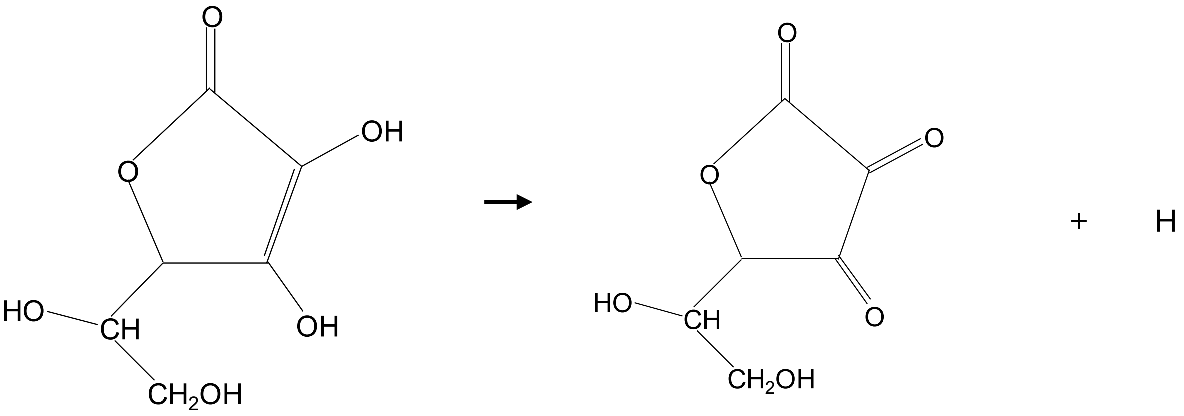
4 % 7KH VWUXFWXUH RI DVFRUELF DFLG LV JLYHQ LQ Table 17 of the VCE Chemistry
Data Book

7KH ORVV RI K\GURJHQ LRQV WR WKH K\GUR[\O JURXSV DWWDFKHG WR WKH FDUERQ DWRPV ZKLFK DFW
LRQV ZLOO EH UHOHDVHG GXULQJ WKH R[LGDWLRQ WR WKH
FKDUJH RQ WKH UHDFWDQWV ZLOO EH EDODQFHG E\ WKH HOHFWURQV RI FKD
DVFRUELF DFLG UHPDLQV]HUR

7KH RQO\ VWUXFWXUH FRQVLVWHQW ZLWK WKH KD


O
O
O
O
HO
CH
CH_2OH

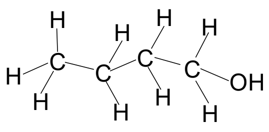
7KH KDOI HTXDWLRQ IRU WKH R[LGDWLRQ LV

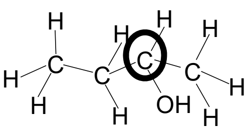

O
OH
O
HO
CH
OH
CH_2OH
O
O
O
HO
CH
O
CH_2OH
+ H

RU +&2 o &+ 2 + H

4 % 7R H[LVW DV D UDFHPLF PL[WXUH WKH VXEVWDQFH PXVW FRQWDLQ D
UHVXOWLQJ IURP D FKLUDO FHQWUH

2QO\ EXWDQ RO KDV D FKLUDO FDUERQ ERQGHG WR IRXU GLIIHUHQW DWRPV
JURXSV RI DWRPV


H
H
C
H
H
C
H
C
H
H
C
H
OH


H
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H
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C
OH
H
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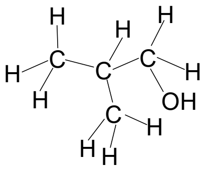
H


H
H
C
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H
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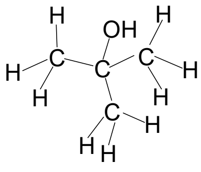
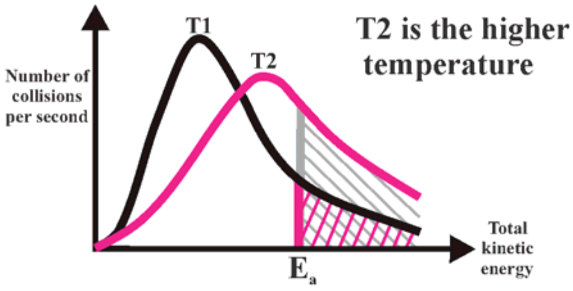
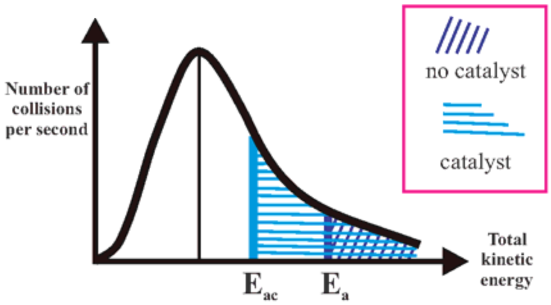
OH
C
H
H
H

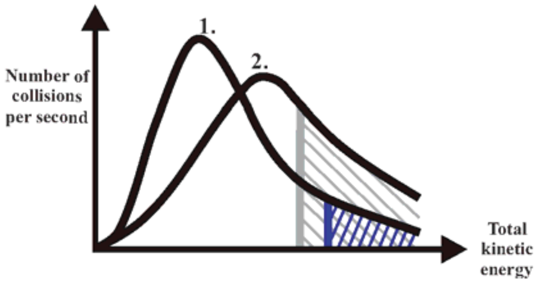

H
OH
H
H
C
C
C
H
H
H
C
H
H
H

Q C The effect of an [illegible]
is represented [illegible] curves





These curves are combined in the curves for conditions 1. and 2., i.e.



So the [illegible] a higher temperature and
catalyst

4 $ (TXDWLRQ IRU WLWUDWLRQ UHDFWLRQ

2+ &22+ D&T +1D2&+D2T+ &221D DT2 O +

Q 1D2+ XVHG × × PRO/ /

× PRO

P ODFWLF ×DFLPG×O J PRO

J

P PLON × PJ/ P/

J

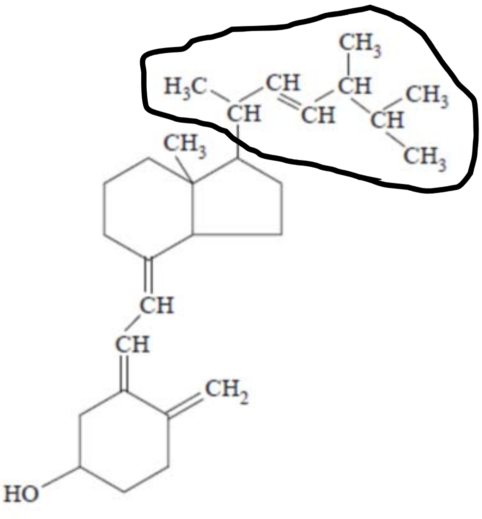
ODFWLF DFLG×

P P

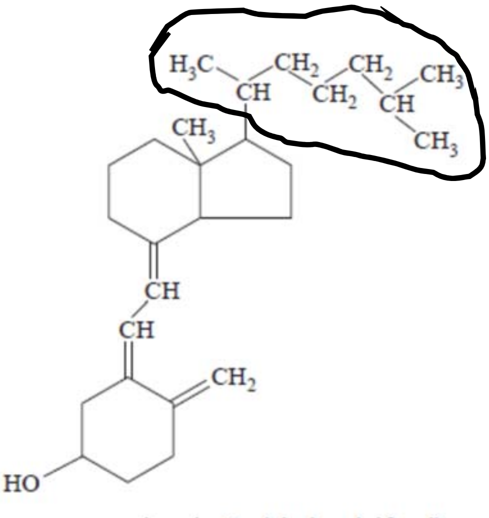
4 ' 7KH VWUXFWXUHVQRIYLWDPLQ'KRZQ LQ 7DEOH LQ

Chemistry Data Book 7KH GLIIHUHQFHEHWZHHQ WKH K\G

FKDLQV DWWDFKHG WR WKH ULQJ VWUXFWXUH



vitamin D_2 (ergocalciferol)



vitamin D_3 (cholecalciferol)

7KH IRUPXODH RI WKH UH&+VSHFWLYH VLGH FKDLQV

7KH H[WUD FDUERQ PHWKRQV LQ KYDLWWDPLQ'QWHUPROHF

IRUFH DWWUDFWLRQG ZLWOO EHHOWWLQJ WHPSHUDWXUH

4 % 7KH FKHPLFDO VKLIW RI D + RU & DWRP LQ D PROHFXOH

LV GHWHUPLQHG E\ WKH UHODWLYH HOHFWURQHJDWLYLW\

E\ WKH DWRPV ([SRVXUH WR WKH VWURQJ PDJQHWLF ILHOG

HOHFWURQV VXUURXQGLQJ WKH DWRP HDFK LV VKLH

UHGXFHG E\ WKH HOHFWURQ FORXG DURXQG WKH QXFOH

PHDQV WKH QXFOHXV LV PRUH H[SRVHG WR WKH H[WHUQDO

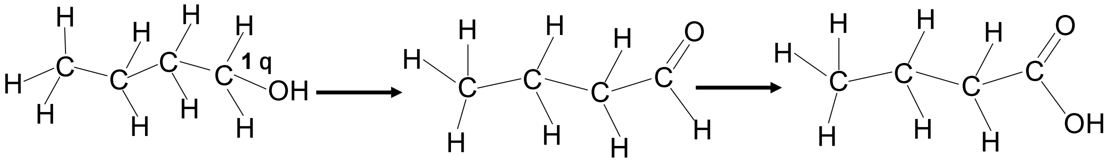
HQHUJ\ JDS EHWZHHQ WKH WZR QXFOHDU VSLQ VWDWHV

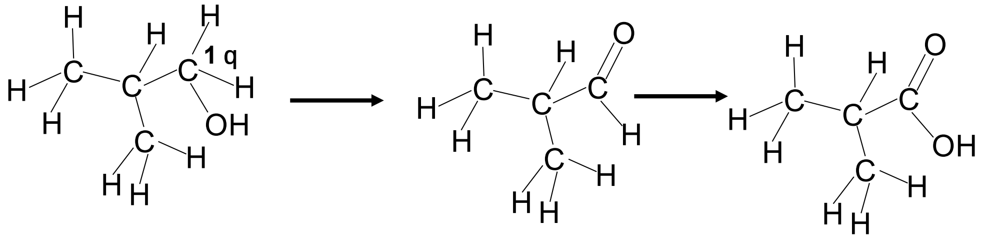
FKHPLFDO VKLIW

4   '   ,Q WKH SUHVHQFH RI DFLGLILHG GLFKURPDWH

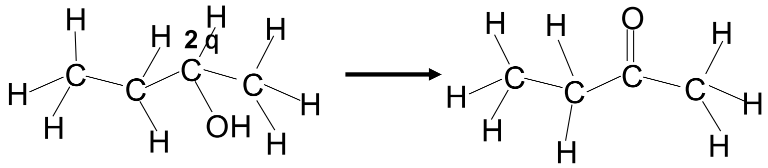
SULPDU\ DOFRKROV SURSDQRO PHWK\OSURSDQ RI [LGLVHG WR

DOGHK\GH DQG FDUER[\OLF DFLGV

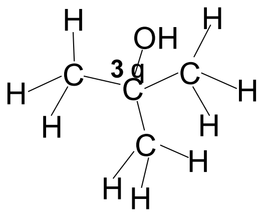




VHFRQGDU\ DOFRKRO EXWDQ RO PHWK\OSURSDQ RO R[LGLVHG WR NHWRQH



WHUWLDU\ DOFRKRO PHWK\OSURSDQ RO QRW R[LGLVHG



;

+HQFH PHWK\OSURSDQ RO ZLOO QRW UHTXLUH WKH GLFKURPDWH

4   % BBBB+BBBo&2&+ Q   BBB2B+

BBBBQ+&2o &+ Q   BBB2B+

BBBBQ+&2o &+ Q   Q+ 2

7RWDO QXPEHU RI +JHW R   Q   Q

Q

1XPEHU RI + DWRPV UHTXLUHG RQ OHIW   Q

1XPEHU RI PROHFXOHV UHTXLUHG RQ O

Q

2YHUDOO HTXDWLRQ

Q +   Q&2o &+ Q   Q+ 2

4 % 7KH DFFXUDF\ RI c W&KH&H2 2G+HWGHHUSPHLQHGIG RQ KRZ FORVH
YDOXH
7KH SUHFLVLRQ GHSHQGV RQ WKH WHUHG SXURGHXFLWEKLH LV
FRQGLWLRQV
FDQQRW EH WFKDOWLRWLKGH DFFXUDF\ WKH VH WKHUH PD\ EH D
WHFKQLTXH FRQW D V\VWHPDWLF HUURU
+RZHYHU WLSOH RI HSHWLWLRQ H[SHULPHQWDO WHFK
FRQGLWLRQV VKRXOG QRW RPSOH DQG VPDOO VFDOH WR DUH
WRJHWKHU L H SUHFLVH

4 $ 7KH HTXDWLRQ IRU WKH UHDFWLRQ LV
1D&2 DT + &O DT &O D2 O + &2
7KH F +&O LV GHWHUPLQHG YLD WKH FDOFXODWL
&2 î F &D9 Q 1D2 î D Q +&O · 9 +&O
5LQVLQJ WKH SLSHWWH ZLWK WKH ZDWHU ZRXOG GLOXWH
FDUERQDWH VROXWLRQ LQ WKH IODVN
ZLOO EH KLJKHU WKDQ WKH WUXH YDOXH
7KLV PHDQV WKH FDOFXODWHG Q +&O WR EH
$OWHUQDWLYHO\ FRQFHQWUDWLRQ RI 1D
9 +&O LQ WKH WLWUH ZLOO EH KLJKHU
7KLV PHDQV 0HJDQ¶V FDOFXODWHG
FDOFXODWHG YDOXH
6LQFH WKH 9 +&O GHWHUPLQHG
WKH ILQDO EXUHWWH UHDGLQJ
WKH ERWWRP RI WKH PHQLVFXV
UHVXOW

4 ' 7KH JO\FDHPLF LQGH[RI D IRRG
FDUERK\GUDWHV LQ IRRG
HIIHFW RQ EORRG VXJDU OHYHOV
+RZHYHU WKH JO\FDHPLF LQGH[
DPRXQW RI FDUERK\GUDWH LQ HDFK IRRG LQ D PHD
7KH DFWXDO DPRXQW RI FDUERK\GUDWH
DV VKRZQ EHORZ

)RRG	&DUERK\GUD J	$FWXDO DP FDUERK\GU	*O\FDHPLF LQGH[
:KROHPHDO EUHDG ±			
$YRFDGR ±			
2PHOHWWH ±			
&KLSV ±			
:DWHUPHORQ ±			

$OWKRXJK WKH KLJK JO\FDHPLF LQGH[
LPSDFW RQ EORRG VXJDU OHYHOV WKHUH LV D DPRX
FDUERK\GUDWH DYDLODEOH
WKH UHODWLYH JO\FDHPLF LQGLFHV
ORDG LQ WKH PHDO
*O\FDHPLF ORDG */ RI D IRRG VWXII FDQ EH FDOF
*/ *, [DPRXQW RI FDUERK\GUDWH
:KROHPHDO EUHDG
$YRFDGR [
&KLSV î
:DWHUPHORQ î

4 & 8VH WKH FRPSRVLWLRQ GDWD WR GHWHUPLQH WKH FRPSRXQG WKH

m 2 m VDPSOH & ± m + @

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n 2

PRO

0ROH UDWLR

& + 2

(PSLULFDO IRUPXOD & + 2

0ROHFXOHV RI DOO WKH DOWHUQDWLYHV

EXWDQRLF DFLG & + &22+

PHWK\O SURSDQRDWH & + &22&+

PHWK\O SURSDQRDWH & + 2

EXWDQ RQH & + &+

DOO FRQWDLQ FDUERQ\O JURXS

7KLV LV FRQVLVWHQW ZLWK

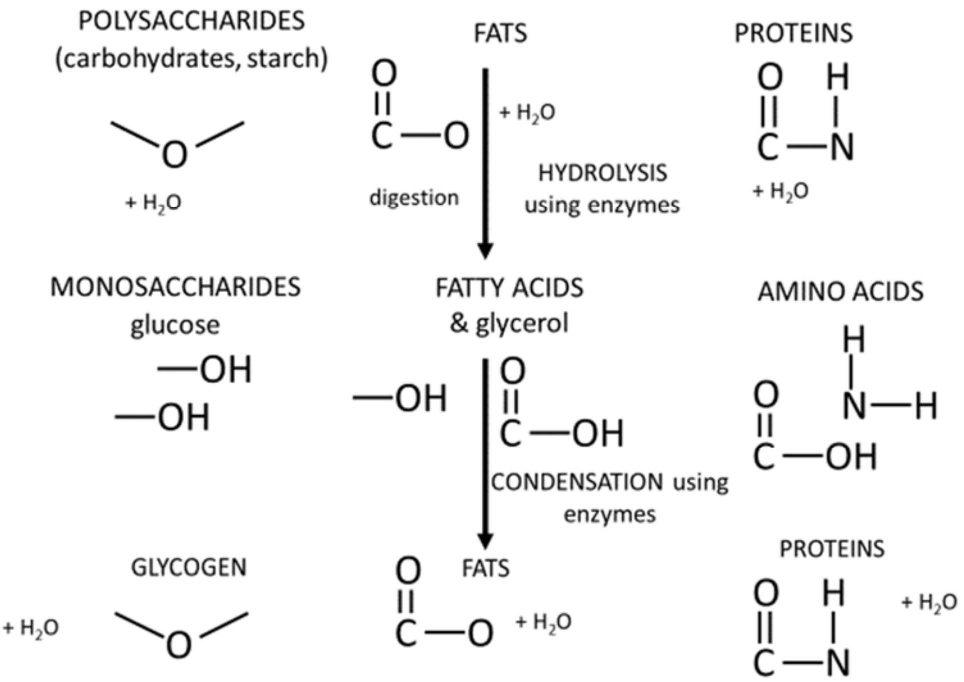
,5 VSHFWUXP GRHV QRW VKRZ D SHDN

2+ DFLG GRHV VKRZ D SHDN LQ WKH DEVRUSWLRQ

&RPSRXQG LV PHWK\O SURSDQRDWH

4 % $ PRUH GHWDLOHG YHUVLRQ RI WKH IORZ FKDUW

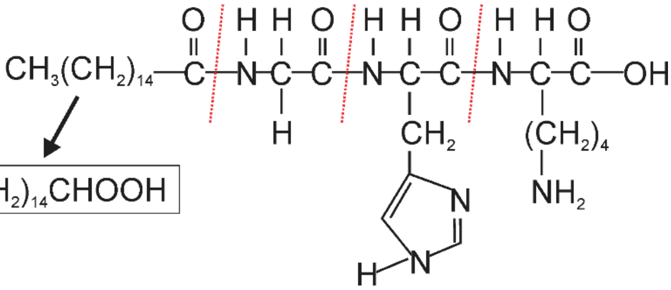
JLYHQ EHORZ


POLYSACCHARIDES
(carbohydrates, starch)
O
+ H₂O
FATS
O
C—O
+ H₂O
digestion
HYDROLYSIS
using enzymes
PROTEINS
O H
C—N
+ H₂O
MONOSACCHARIDES
glucose
—OH
—OH
FATTY ACIDS
& glycerol
—OH
O
C—OH
CONDENSATION using
enzymes
AMINO ACIDS
H
O
N—H
C—OH
GLYCOGEN
+ H₂O
O
FATS
O
C—O
+ H₂O
PROTEINS
O H
C—N
+ H₂O

7KHUH DUH VL[IXQFWLRQDO JURXSV LQYROYHG FDUER[\O DPLGH SHSWLGH DQG DPLQR

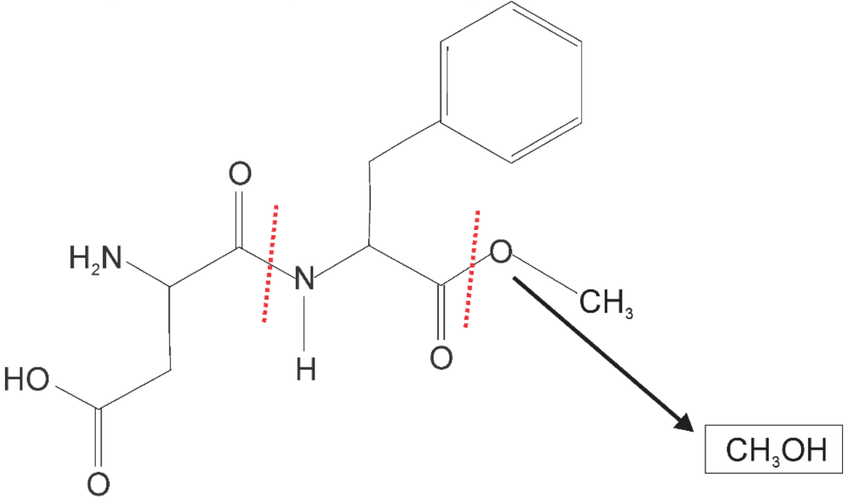
FDUER[\O DPLGH SHSWLGH DQG DPLQR

4 & +\GURO\3VDLOVPRLWR\ZOL*+O.Q USHOHDWHF DFLG 2&+DQWKUHH
DPLQR DFLG\VFLQH KLV Widentified from Table 17 in VCE Chemistry
Data Book.



CH3(CH2)14—C(=O)—NH—CH2—C(=O)—NH—CH(CH2-imidazole)—C(=O)—NH—CH((CH2)4NH2)—C(=O)—OH
CH3(CH2)14CHOOH

+\GURO\$VLVSDRIWZDPH UPHWKDQRO &QWZR DPLQR DFLG
DFLG DQG SKHQ\ODODQLQH



O
H2N
N
H
HO
O
O
CH3
O
CH3OH

8QGHU DSSURSULDWHFRQGLWLRQV UHDFW ZLWK\
SDOPLWLFDFLG+HDO
&+ &22+ & &2++o &+ &+ &22&+ +2
,Q DONDOLQH VROXWLRQ *+HQV DQG $VSDUWDPH ZLOO D
ERWK KDYH D VLQJOH FKDUJH RI\O EH UHGXFHG SURGXFWV
WKHLU DPLQR DFLG VLGH FKDLQV

4 ' 7KH HTXDWLRQ IRU WKH FRPEXVWLRQ RI PHWKDQH LV
&+ J 2J o &2 J 2+ J
6LQFH PRO &+ UHDFWV ZLWK WR PROHV J PRO &2 PRO WKHQ
VLQFH DOO YROXPHV DUH PHDVXUHG DW WKH VDPH
UHDFWLRQ LV WKH UDWLR DV LQ WKH HTXDWLRQ
6R P/ &+ UHDFWV ZLWK J L/H2 DQG &2 P/ +
&2 DQG 2 DUH DOO JUHHQKRXVH JDVHV
,QLWLDO YROXPH VJ &+ HHQKRXVH JDVHV
P/
)LQDO YROXPH JUHHQKRXVH JDVHV
P/ P/
PRO
&KDQJH LQ YROXPH RI JUHHQKRXVH JDVHV LV DQ

4 & $FFRUGLQJ WR VCE Chemistry Data Book WKH KHDWV RI FRPE

FRPSRXQGV LQ 0 DUH

0HWKDQRO N- J

2FWDQH N- J

0 LV PHWKDQRO DQG RFWDQH

V &+2+ LQ / 0 î /

m &+2+ d î V J î/ /

J

V &+ LQ / 0 î /

m &+ d î V J î/ /

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7RWDO HQHUJ\ FRQWDLQHG î Jî J N- J

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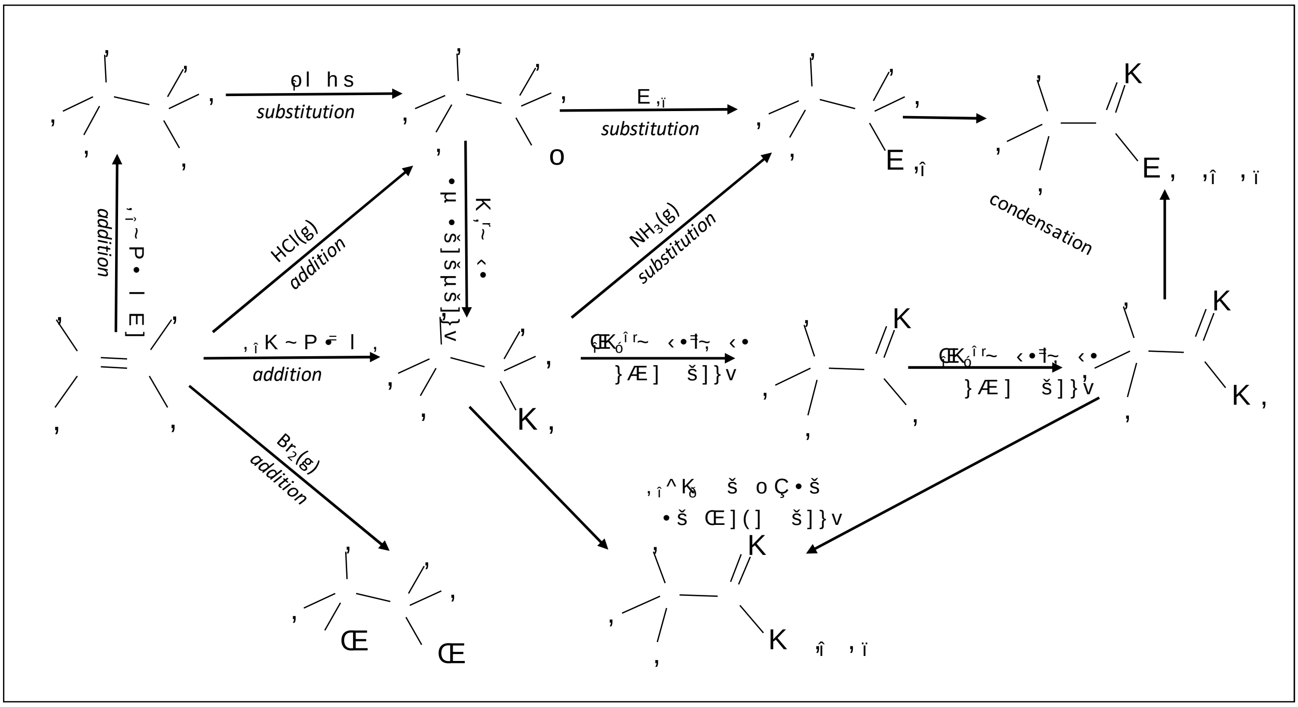
4 % +%U LV QRW SDUW [illegible] GHWDLOHG


substitution
substitution
condensation
HCl(g)
addition
NH₃(g)
substitution
addition
addition
Br₂(g)
addition

4 & Q It

I — $ $

t \HDUV

î î î î VHFRQGV

îV

Q î î î

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PRO

2[LGDWLRQ KDOI HTXDWLRQ /L

n /L PRO

m /L îPROJ PRO

J

4 % 6SHFLHV SUHVHQW LQ WKH FKORU DONDOL FHOO DUH

$FFRUGLQJ WR WKH SRZHU RI R[LGDWLRQ UHGXFWLRQ

7KH SURGXFWV RI WKH HOHFWURO\VLV RI 1D&O DT

VHULHV

$Cl_2(g) + 2e^- \; o \; 2Cl^-(aq)$ 1.36 V

$O_2(g) + 4H^+(aq) + 4e^- \; o \; 2H_2O(l)$ 1.23 V

$2H_2O(l) + 2e^- \; o \; H_2(g) + 2OH^-(aq)$ -0.83 V

$Na^+(aq) + e^- \; o \; Na(s)$ -2.71 V

2 O ZLOO EH UHGXFHG ZKLFK LV WKH VWURQJHVW R[LGDQW

$W WKH DQRGH ± WKH SRVLWLYH HOHFWURGH &O ZLOO

EH R[LGLVHG 8QGHU VWDQGDUG FRQGLWLRQV

EH SURGXFHG 7KLV LV HOHFWURO\VLV

&O DT

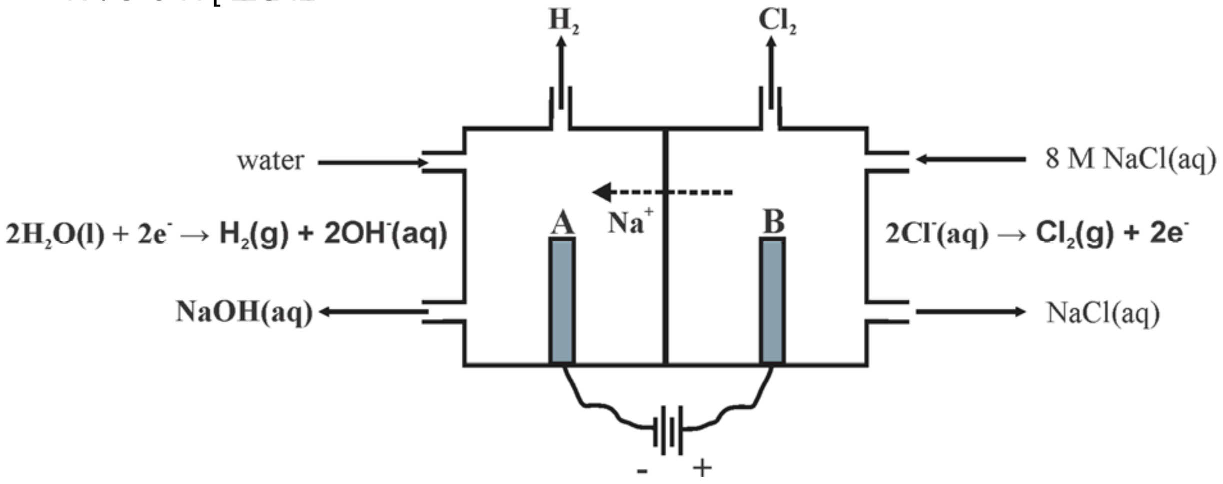
+DOI HTXDWLRQV IRU WKH HOHFWURGH DT DUH

HOHFWURGH &O &OH

HOHFWURGH + +

6R WKH FRPSRXQG ZKLFK LV IRUPHG FRQWLQXRXVO\

K\GUR[LGH 1D2+



H₂
Cl₂
water
8 M NaCl(aq)
$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$
A
Na^+
B
$2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$
NaOH(aq)
NaCl(aq)
-
+

6(&7,21 % ± 6KRUW $QVZHU $QVZHUV

4XHVWLRQ PDUNV

D 0DVV RI VSLULW [illegible]
DOO IRXU DOFRKROV
7HPSHUDWXUH FKDQJH RI WKH ZDWHU LQ WKH FDQ

E 0ROHFXODU PDVV PRO U PDVV RI WKH DOFRKROV
7KH LQGHSHQGH[illegible]
KDYH GLIIHUHQW [illegible] VL]HV

F 2QH RI
9ROXPH PDVV RI ZDWHU EHLQJ KHDWHG
'LVWDQFH EHWZHHQ EXUQHU DQG ZDWHU FRQWDLQHU
/HQJWK RI ZLFN H[WHQGHG IURP EXUQHU
$PRXQW RI VWLUULQJ RI ZDWHU
&RQWUROOHG YD[illegible]
RXWFRPH RI WKH [illegible]
LQGHSHQGHQW[illegible] SURGXFHG

G (QHUJ\ DEVRUEHG E\ [illegible] & - J

n &+&+&+2+ J J PRO
PRO
0RODU KHDW RI FRPEXVWLRQ PRO
- PRO
N- PRO

H 'XULQJ WKH FRPEXVWLRQ [illegible]
QXPEHU RI & & DQG & + ERQGV ZKLFK [illegible]
ERQGV IRU[illegible]HUJ\ UHOHDVHG [illegible]
ZKHQ & 2 DQG 2 + ERQGV DUH IRUPHG [illegible]
ERQGV [illegible]DUJHU WKH DOFRKRO PROHFXOHV [illegible]
ERQGV EURNHQ DQG & 2 DQG 2 + ERQGV [illegible]
UHOHDVHG LQ WK[illegible] DOFRKRO

I 7K[illegible]
WKH DOFRKRO [illegible]
HQHUJ\ UHOHDVHG GXULQJ FRPEXVWLRQ
3RVVLEOH PRGLILFDWLRQV FRXOG EH
r SXWWLQJ D OLG [illegible]RVV IURP WKH
r DGGLQJ D SURWHFWLYH [illegible]

J HIILFLHQF\ [illegible]

VCE Chemistry Data Book

K 7KH FDORULPHWH[illegible] WKH
WKHUPRPHWHU 7K[illegible] WHFK

4XHVWLRQ PDUNV

D + J J⇌ + , ➊

E 7KHFRQFHQWUDWLRQ RI HDFK VSHFLHV LQFUHDVHV DQG WKHQ ...
LV QR FKDQJH DIWHU ...
GHFUHDVHV ZLWK WLPH VLQFH WKH ...
SURGXFHG EHFRPH LQ ...
UHDFWDQW FRO ...
UDWH RI WKH UHYHUVH ...
ZKHQ WKH UDWHV RI WKH IRUZDUG DQG UHYHUVH ...
FKDQJH LQ DPRXQWV RI UHDFWDQWV ...

F *K* >+ , @>@ ➊

n + ,*V* *n* + *V* î *n* , *V*

n + , *n*^+ î *n* , `

î

➊

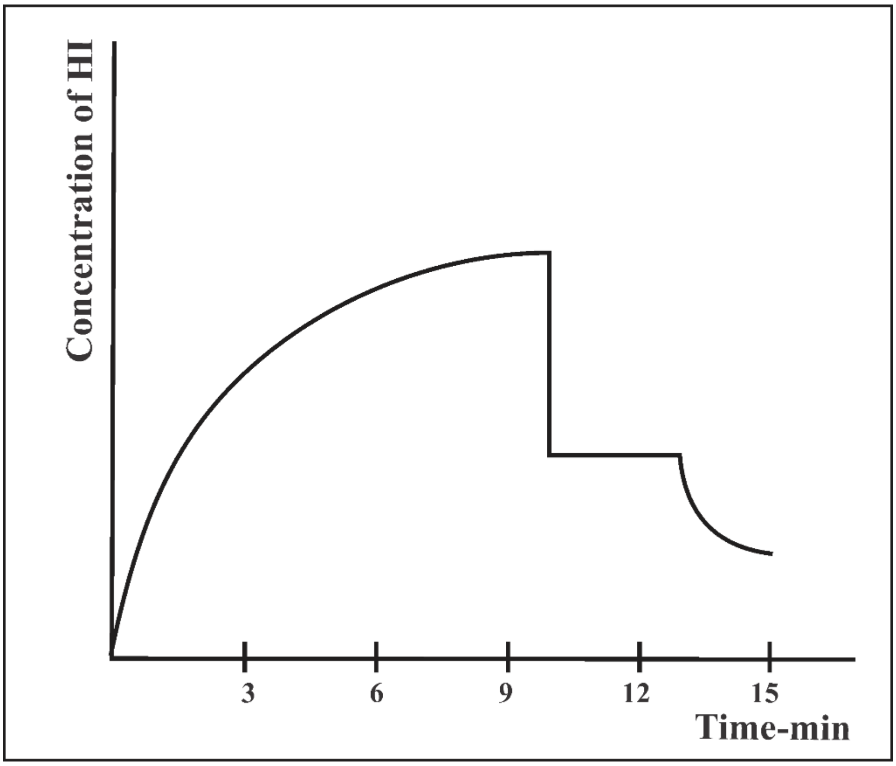
There are the same number of particles on both sides of the equilibrium, so

L WKH DFWXDO YROXPH ...
RXW

LL . GRHV QRW KDYH DQ\ XQLWV

G 7KH YROXPH LQFUHDVH ZRXOG FDXVH D ...
SUHVVXUH ...
HTXLOLEULXP LW FDQQRW VKLIW ...
UHDFWDQWV DQG SURGXFWV ➊ SUHVHQW GR QRW FKDQJ ...
7KH GHFUHDVH LQ ...
H[RWKHUPLF ...
ZDV ... UHDFWLRQ

H



7K>H+,@ VWDUWV DW]HUR DQG LQFUHEDULHXPWD WKWHKH PVL\
PDUN U7DKWHH RI LQFUHDV@H DQ@G OS>V,H EU>H+W,@HHL>V+ FRQVWDQW
PLQ❶WHV

$W WKPHLQXPWDHUN >+W,@HKDOYHV GXH WXEROLWQKJH DYQRGO XPHPDGLRQ
OHYHO XS WR WKH❶ PLQXWH PDUN

%HWZHPHLQQXWHV DQG PLQXWHV WKH >+F,@LRQFLUVHDDV
E\ WKH WHPSHUD❶WXUH GHFUHDVH

4XHVWLRQ PDUNV

D & V J2o & 2 oJr & V oJ2o & 2 ❶

E ([SRVXUH WR &2 FDQ DIIHFW WKH OFRDSG FLRWVF RUFKHVL2HRVRLJ
ERG\
2[\JHQ FRPELQHV ZLWK KDHPRJOREULQH VHQWDQGHEX\WOKLHE
+E DT J 2⇌ +E2 DT❶
+RZHYKHUHPRJORELQ FRPELQHV PRUH DUQHGG VLROLQ ZLWKKH &S2U
&2 D FRPSHWLQJ UHFXUHLVEHULQWXPLGRE\ EWHKOHR ZTXLD VHW XS
+E DT &2⇌ J+E&2 DT❶
7K+HE &2 HTXLOLEULXP KDUVHDT XPLXOFLKE KLXKP KHR ⊕EV W2TDXQLW LWEK
DQG VR LQ WKH SUHVLHVQIFRHU RHH &2 WR+ EDO2FH ORUDG GHQLJWWV2
+E2 DT &2⇌J +E&2 DT J❷
&RQVHTXHQWO\R &2KLHV FFHDORUDOO\RHG LKQVWKHDQ KWHKUH QHFHVVDU
F 1RQ IDWDO &2 SRLVRQLQJ FDQ EH WUHDWHG E\ KLJK FRQFHQWUDWLRQ[\JHQ ZKLFK FD
D+T E &2⇌J +E&2 DT J2
WR VKLIW WR WKH OHIWWRDQG WKHUH EH +ED❶ULV LHDQJKHDQFH2HG

4XHVWLRQ PDUNV

D %RWK OLQROHQLF DQG OLQROHLF DUH SRO\XQVDWXUDWHG DV WKH\ KDYH DW OHDVW WZR &W&\ GR

7KH NH\ VWUXFWXUDO GLIIHUHQFH LV WKH SRVLWLRQ RI WKH & & GRXEOH ERQG FORVHVW WR WKH & PRLHWLHV LQ WKH K\GURFDUERQ FKDLQ ... RQ R

& & GRXEOH ERQG IXUWKHVW ❶URP WKH FDUER[\O JURX

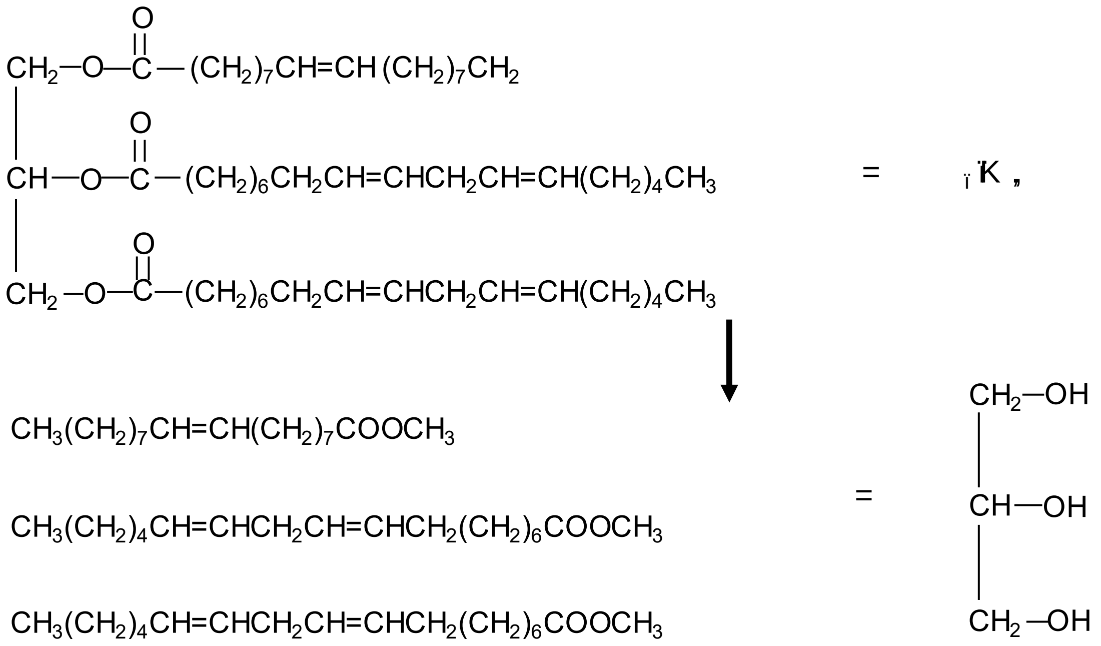
D OLQROHQLF DFLG

&+&+&+ &+&&+ &+&&+ &+&&+&+&+&+&+&+&22+ 2PHJD

J OLQROHQLF DFLG

&+&+&+&+&+&+ &+&&+ &+&&+ &+&&+&+&+&+&22+ 2PHJD

E


O
CH$_2$—O—C—(CH$_2$)$_7$CH=CH(CH$_2$)$_7$CH$_2$
O
CH—O—C—(CH$_2$)$_6$CH$_2$CH=CHCH$_2$CH=CH(CH$_2$)$_4$CH$_3$
O
CH$_2$—O—C—(CH$_2$)$_6$CH$_2$CH=CHCH$_2$CH=CH(CH$_2$)$_4$CH$_3$
=
ïK„
CH$_3$(CH$_2$)$_7$CH=CH(CH$_2$)$_7$COOCH$_3$
CH$_3$(CH$_2$)$_4$CH=CHCH$_2$CH=CHCH$_2$(CH$_2$)$_6$COOCH$_3$
CH$_3$(CH$_2$)$_4$CH=CHCH$_2$CH=CHCH$_2$(CH$_2$)$_6$COOCH$_3$
=
CH$_2$—OH
CH—OH
CH$_2$—OH

❶ IRU FRUUHFW IDW VWUXFWXUH

❶ IRU FRUUHFW QXPEHU RI PHWKDQRO PROHFXOHV

❶ IRU WKUHH K\GURFDUERQ HVWHU IRUPXODH

F 1R &2 LV SURGXFHG IURP WKH FRPEXVWLRQ RI ELRGLHVHO DQ FRPSRQHQWV RI WKH ELRGLHVHO DUH GHULYHG IURP FDUERQ IL[HG E\ WKH SODQW IURP PXVWDUG VHHG RLO LV HIIHFWLYHO\ &2 QHXWUDO IURP LWV FRPEXVWLRQ DUH DEVRUEHG E\ WKH DWPRVSKHUH SKRWRV\QWKHVLV LQ WKH JU❶R ZWK RI WKH VHHGV WKDW DUH IRVVLO IXHO QRW IRU WKH IRUPDWLRQ &2 RQV GXULQJ ❶ 6R VXEVWLWXWLQJ ELRGLHVHO IRU IRVVLO IXHOV UHGXFHV WKH DPRXQW RI &2 DGGHG WR WKH DWPRVSKHUH

G L 7KH VXUIDFWDQW PROHFXOHV KDYH D SRODU ZDWHU ORYLQJ SDUW DQG D QRQ SRODU SDUW PROHFXOHV DOLJQ RQ FRQWDFW ZLWK WKH QRQ SRODU PROHF❶XOHV

LL %LRGLHVHO PROHFXOHV DUH PRUH VROXEOH LQ ZDWHU JURXS WR ZKLFK ZL FDQ ERQG WR WKH ELRGLHVHO PROHFXOHV SUHVHQW Z ZDWHU WKDW F❶DQ EH SUHVHQW

H 7KH SURGXFWLRQ RI WKH HIILFLHQW ELRGLHVHO FDQ EH JRRG DQG ELRGLHVHO SURGXFHG PRUH FKHDSO\ GXH WR WKH ORZHU FRVW RI ZDWHU LQFRPH IURP WKH VDOH RI OHIW❶RYHU PDWHULDO DV D

f 7KH &)33 UHIOHFWLRQ WKH WHPSHUDWXUH VKFHWKHRUHWFXRQHJ\U WK
LQWHUPROHFXODU DWWUDFWLRQ %HWZHHQ FKDLQV KLJKHU EHWZHHQ &
KDYH KLJKHU &)33 FDXVH GXH WR VWURQJHU VSHFLILF VXUIDFH
PROHFXOHV WR ORQJHU LQWHUPROHFXODU SDWWHUQV DQG GLVSHUVLRQ
g m SHWURGLHVHO J / /
î J
(QHUJ\ UHOHDVHG IUîRP SHWURGLHVHO
î N❶
m % î N- N- J
î J
❶W
h %UDVVLFDFLF KDV KLJKHU PHOWLQJ WHPSHUDWXUH
%RWK DFLGV KDYH WKH VDPH PROHFXODU IRUPXOD D
WKH GHWHUPLQLQJ IDFWRU FRXOG EH WKH VWUXFWXUH DURXQG
DURXQG WKH & & GRXEOH ERQG DUUDQJHPHQW DQG EUD
DFLG WUDQV DUUDQJHPHQW FDXVHV EHQW DUUDQJHPHQW LQ HU
DFLG SUHYHQWV LW IURP JHWWLQJ FORVH DV WKH FKDLQV
EUDVVLGLF DFLG PROHFXOHV

4XHVWLRQ PDUNV
a 6LQFH WKH FRPSRXQGV FRQWDLQ K\GURJHQ DQG FDUERQ D
b 7KH IXHO ZRXOG EH WKH &+ &22&+ PHWK\O ROHDWH
&RPEXVWLRQ HTXDWLRQ
+ &22&+ O 2 &2 J +2 J ❶O
c 0XFK RI WKH FDUERQ LQ WKH FDUERQ FKDLQ LV FRQYHUWHG WR FDUERQ
ZKLFK LV QRW GLVSHUVHG DV SDUWLFOH SROOXWDQWV
d i 8ELTXLQRQH FRQWDLQV WZR XELTXLQRQH KDV E
FRQYHUWHG WR WZR FDUERQ\O JURXSV
8ELTXLQRQH DFWV DV DQ DQWLR[LGDQW R[LGLVHG WR
& 2❶
ii)DW VROXEOH GXH WR WKH ORQJ K\GURFDUERQ
VLJQLILFDQW GLVSHUVLRQ IRUFHV DQG QRQ SRODU IDW PRO
e 0DQ\ HQ]\PHV DUH SURWHLQV ZKLFK KDYH PRUH RI
WHUWLDU\ VWUXFWXUH WR PDLQWDLQ WKHLU DFWLYH
VLWH PRGLI\LQJ LWV DELOLW\ WR ELQG WR VXEVWUDWH
QHFHVVDU\ IRU UHDFWLRQ LV DFWLYDWHG
f (Q]\PHV DUH SURWHLQV ZKRVH VWUXFWXUH
EH DEOH WR LQWHUDFW ZLWK WKH VXEVWUDWH
VWUXFWXUH RI WKH ❶SURWHLQ

4XHVWLRQ PDUNV

D &+&+2+ DT &+&+2 DT DT ❶ H

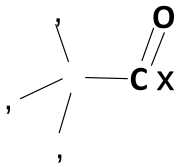
7KH R[LGDWLRQ YRHVHWKHDQRO LV RYWKHQW RZLDHQK FRKQHVµLV

dehydrogenase ¶ QDPH RI W❶KH HQ]\PH

E 1$' DFWVRD[LVGD❶WKHQ G LV UHGXFHG HQJ D LDQFLFRJU KGLQJ WR

1$' DT ED T o H1$'+ D❶

F &+&2x ❶

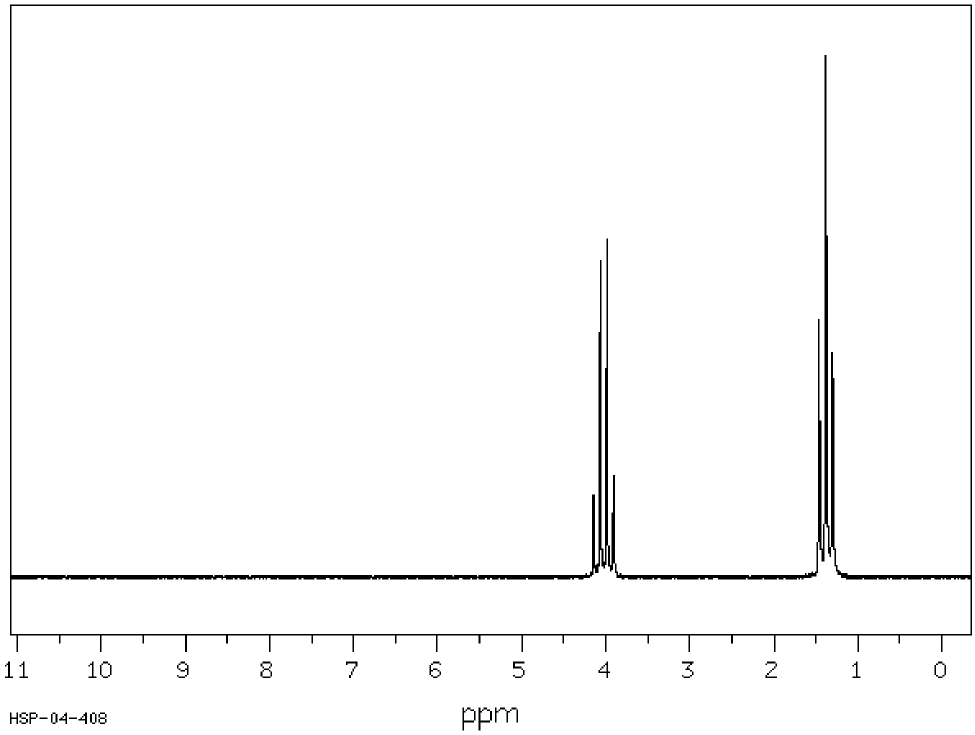


G &+ 16 « IURP &+ 161 &+&+ ❶

H 'LVXOILUDP LV DRY\HPFXHOWHU ZEDWK PR&+U HUR\SDOHQW &+

7KH 105 VSHFWUXP ZLOO VHFRQ WRDOVLWUDQVLWRQ &+

❶DQG TXDUWHHRQ ❶&+ DFFRUGLQJ WR WKH Q UXOH



I *V* HWKDQRO LQ P/ JODVV RI ZLQH î

P/

m HWKDQRO LQ P*V* JHOWDKVD*d*QRIRWZKLDQHRO

Pî/ J P/

❶J

7LPH WR SURFHVV HWKDQRO LQ JPS/HJUOKRXUI ZLQH

KR❶XUV

J &+ 2 DTo &+&+2+ DT &J2❶

)HUPHQWDW[LRQKHUV PDLQF EUHGHG FLW LWKRQH HGH DWDQSURWG XGLVVLS

WKH FDWDO\VW PD\ EHFDRVHH L\QYHIILHVF WDQ YHHQ]\PHFHQG H

DOO SURWHLQV FDQ GHQDWXUGH LDQWKKLH KSWHHPSHUHDWR

FDXVLQJ WKHWDRFEHVLH YHHH❶LVWHH IHFWLYH

4XHVWLRQ PDUNV

D *m* &2 SURGXFHG LQ JDVîLILFDWLRQ PRO J

(QHUJ\ UHTXLUHG N- J J

%URZQ FRDO o î 0-N-JLQ o JN- J

m EURZQ FRDO QHHGHG N- N- J

E 2YHUDOO HTXDWLRQ RU EDODQFHG HTXDWLRQ

& V 2 2+ J o + J &2

7KH &2 SURGXFHG LQ WKH SURFHVV VKRXOG EH FDSWXUHG DQG QRW UHOHDVHG LQWR DWPRVSKHUH

)RU &&6 WR EH IHDVLEOH

VXLWDEOH VWRUDJH PXVW EH DYDLODEOH

IRUPDWLRQV GHHS XQGHUJURXQG

VLQFH &2 ZRXOG EH VWRUHG XQGHU SUHVVXUH WKH ORF OHDNSURRI XQGHU WKLV SUHVVXUH

WHFKQRORJ\ PXVW EH DYDLODEOH WR FRQWDLQ UHOHDVH RI &2

F +\GURJHQ LV IODPPDEOH LQ DQ DLUWLJKW FRQWD DQ\ SRVVLEOH LJQLWLRQ VRXUFHV

+\GURJHQ LV WUDQVSRUWHG XQGHU SUHVVXUH LQ ZHOO SUHVVXULVHG FRQWDLQHUV

G 1HJDWLYH HOHFWURGH R[LGDWLRQ RQ WKH DQRGH HQYLURQPHQW

+ J 2+ DT o + 2 O H

H L (OHFWURO\VLV RI WKH ZDWHU LV LQHIILFLHQW LRQV RWKHU WKDQ PLQLPDO DPRXQWV RI SXUH ZDWHU PLQ HOHFWURO\WLF FRQGXFWLRQ

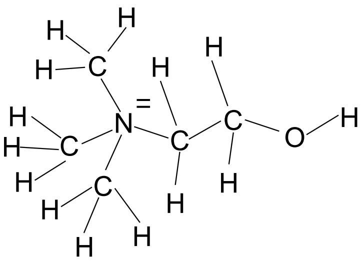
LL 8VH HOHFWULFDO HQHUJ\ WR EH FRQYHUWHG WR FKHPLFDO HQHUJ\ GLOXWH DTXHRXV VROXWLRQ RI VRGLXP FKORULGH

&DWKRGH +2 H DT o + J 2+ DT

I ,QFLGHQW IUHH HQHUJ\ SHU FHOO LV RQO\ DERXW SHU FHQW RI WKH HQHUJ\ IXHO FHOOV DUH IDU PRUH HIILFLHQW EHFDXVH HQHUJ\ WR HOHFWULFDO HQHUJ\ RFFXUV LQ D VLQJOH

4XHVWLRQ PDUNV

D L &+ 1 &+&+2+ ❶



3URGXFWV RI K\GUR1&+\&+2+ZDHQG&22+ L H WKH HVWHU

LQ DFHW\OFKROLQHRZDV K\GUR\[HO WDXEG D FDUER[\O JUR

LL4XDWHUQDU\ HVWHU WKH UDFW DWRP LV ERQGHG WR I

FDUERQ DWRPV DV LQ WKH DPPRQLXP LRQ LV ERQ

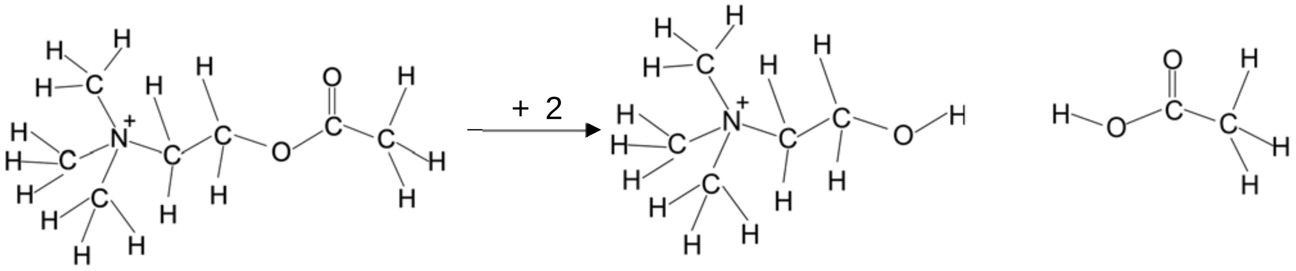
K\GURJHQ DWRPV

7KH LQ FRXUVH TXDQWLW\ WR WKH WHUP ❶ WKH

TXDWHUQDU\ VWUXFWXUH DWWULEXWHG WR WKH KHDG JURXS

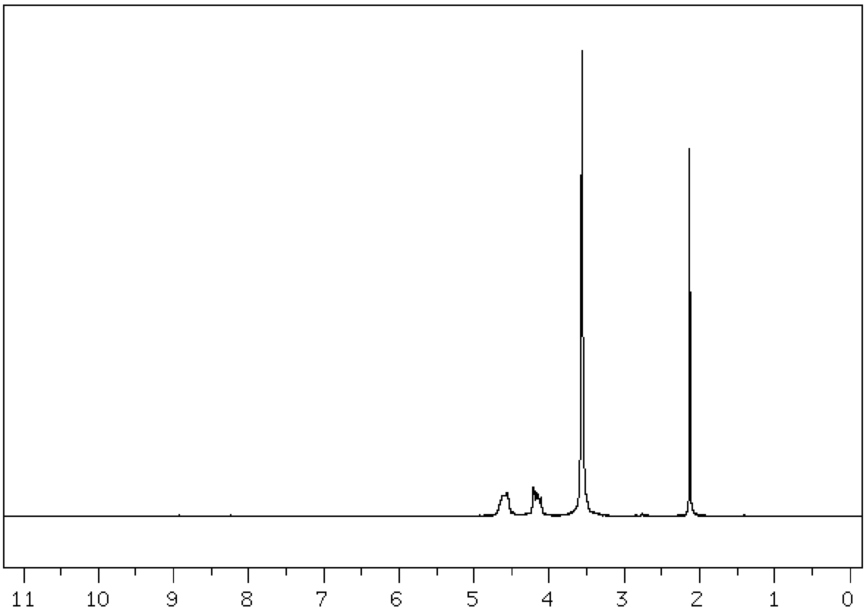
OLQNHG WR JHW KHU FRPSOH[LV SUHVHQW LQ HDFK DV KDHP

E 7KH K\GURO\VLV RI DFHW\OFKROLQH HTXDWLRQ FRUG



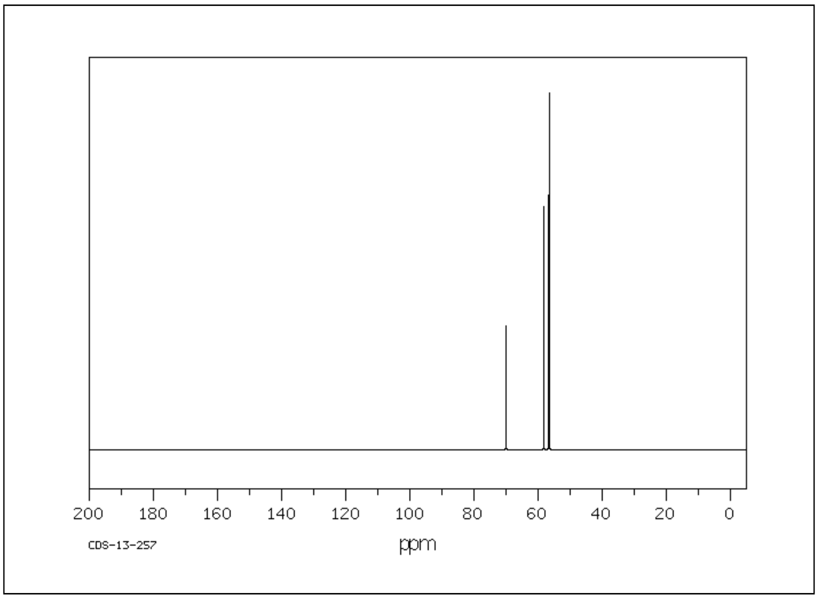
DFHW\OFKROLQH FKROLQH

L 6SHFWUXP



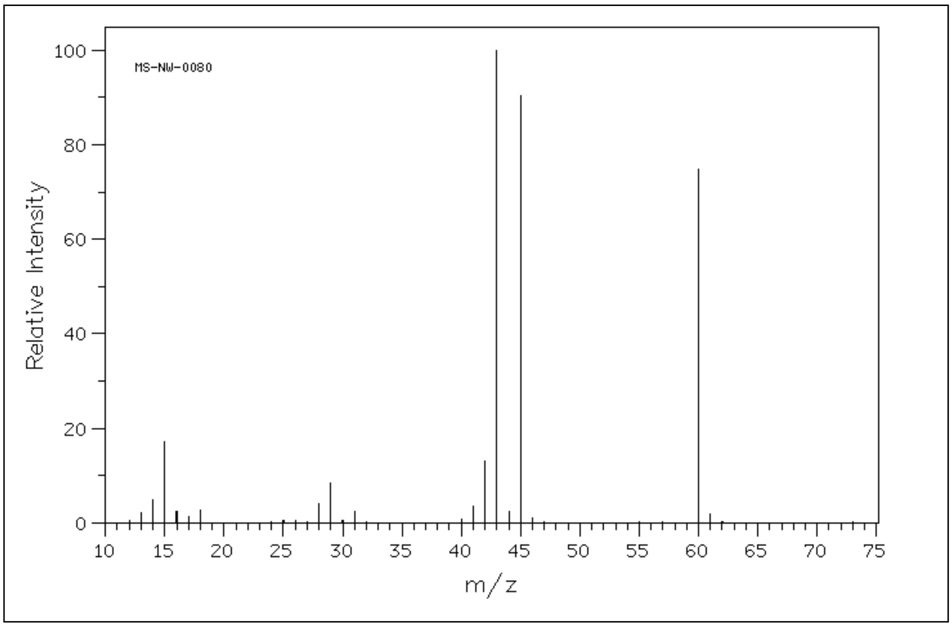
7KLV ±V1 05KH SHFWUXP RI DFHWLF FRQOLQXH SHFLHV ZLW
GLIIHUHQW K\GURJH❶Q HQYLURQPHQWV

6SHFWUXP



7KLV L& 1W0KHV SHFWUXP ±RLWFKLRVOLQHWKSHFLHVIZHUHQW
FDUERQ HQY❶URQPHQWV

6SHFWUXP



7KLV PDVVWKVSHFWUXP RI DFHWKDQRHLFSDFLHDQW SHD
P] FRUUHVSRQGV ZLWK WK&H2 2P+R❶OHFXODU PDVV
LL 7KH SHDN ZLWK UHODWLYH ELQWHQVLW\DWVPRFLD
ZLWK PRWKH DEXQGDQW XQSDLUHG IURP IUDJPHQWDWL
VSHFWURPHWHU
6SHFLHV)RUPXOD❶D ±

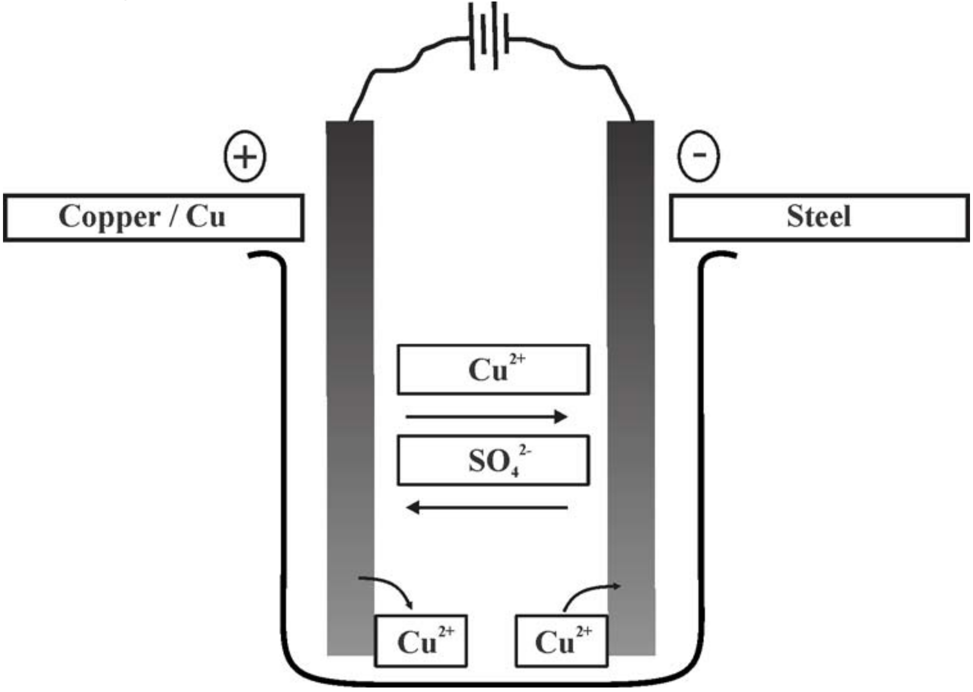
F &RPSRXQGV LQ QHUYH DJHQWV *acetylcholinesterase* ELQG LQJ WR WKH VHULQH
GLVUXSW WHUWLDU\ VWUXFWXUH ZLWK WKH DFWLYH VLWH
7KLV ZRXOG UHGXFH WKH HQ]\PH·V DELOLW\ WR EUHDN GRZQ DFHW\

G 3UDOLGR[LPH +E2&O UHGXFHG &
+12&O UHTXLUHG LQ PLQXWHV PJ NJ
î PJ J
+12&O UHTXLUHG LQ PL J J PRO
î PRO
+12&O UHTXLUHG LQ PLQXWHV î
î PRO

5DWH DGPLQLVWHUHG KRXU

4XHVWLRQ PDUNV

D



IRU FRUUHFW HOHFWURGH VLJQV
IRU FRUUHFW ODEHOOLQJ RI HOHFWURGHV
IRU FRUUHFW LRQV LQ HOHFWURO\WH

E ,QGHSHQGHQW YDULDEOH ±
'HSHQGHQW YDULDEOH &KDQJH LQ PDVV RI SODWH

F 7KUHH IURP
(OHFWURO\WH FRQFHQWUDWLRQ HOHFWURGH VXUIDFH DUHD
WHPSHUDWXUH DQG WLPH

G HIILFLHQF\ >DFWXDO P &X GHSRVLWHG@ P &X GHS
5HGXFWLRQ KDOI HTXDWLRQ &X
&ODULVVH $FWXDO P &X GHSRVLWHG J
4 ,W î î î &
4) î Q H PRO
7KHRUHWLFDO P &X GHSRVLWHG ò
J
HIILFLHQF\ DFWXDO PDVV WKHRUHWLFDO PD
î

H 3RVVLEOH UHDVRQV

0DVXG GLG QRW DGG WKH GWKHQH HFWRSUFHGQUH SSOLRU WR ZHLJK

&ODULVVH DFFLGHQWDOO\ KDG HOHFWURGHV LQ FRQWDFW

SODWHG HOHFWURGH

6RPH RI WKH FRSSHU RQ SODWHG HOHFWURGH ZDV UR[LGL

I DT &LV [LPXOWDQHRXVO\ SURGXFHG DQG DW WKH DQRG

J ,Q WKH RULJLQDO FRQSSHU VXOSKDWH VROXWLRQ DW WKH FDWKRG

WR WKH HOHFWURGH WKURXJK WKH PDVV RI

FKDQJH LQ WKH HOHFWURGH PDVV

:KLOVW WKLV ZRXOG EH HIIHFWLYH IRU SDUWLFOHV

WKH HOHFWURGH WR EH D QHW ZHLJKW RI

4XHVWLRQ PDUNV

D 'XULQJ WKH GLVFKDUJH

6LQFH &X LV D ZHDNHU R[LGDQW WKDQ =Q

R[LGDQW WKDQ =Q

'XULQJ GLVFKDUJH =Q VHHV &X

UHGXFHG DW WKH FDWKRGH

SXPSHG RYHU WKH &G HOHFWURGH SXPSHG RYHU WKH

HOHFWURGH

=Q V =Q DT H

&X DT H &X V

E 'XULQJ UHFKDUJLQJ =Q LRQ DW WKH HOHFWURGH

DT =Q V

F 9Eq R[LGDQW Eq Eq

Eq &H &H ± *from* Table 2 of the VCE Chemistry Data Book

Eq &H &H

Eq &H &H ±

G ,Q D FRQYHQWLRQDO FHOO

WKUHH GR[IORZ EDWWHU\ WKH UHDFWDQWV

DV UHTXLUHG DV KDS

FKDUDFWHULVWLF RI IXHO FHOOV

H L *HQHUDO UHDFWLRQ

LQYROYHG LV

&+ &+ &2 &+&+ 2+ &+&+2 &+&22+

&+ &22&+&+

PDVV VSHFWUXP LRQ SHDN DW SHDN DW

mz

+ 105 VSHFWUXP

TXDUWHW VLQJOHW WULSOHW

7KLV GDWD LV FRQVLVWHQW ZLWK &+ &22& +HVWHU

Mr &+&22&+&+

r mz LV FRQVLVWHQW ZLWK

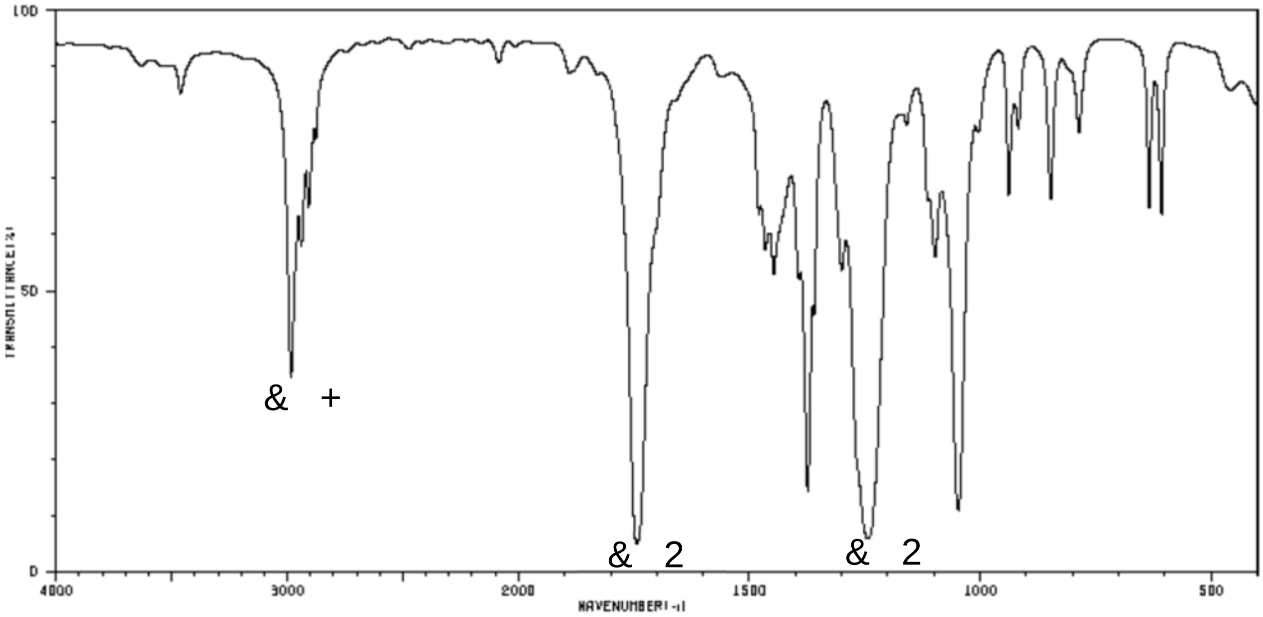
r WKUHH GLIIHUHQW K\GURJHQ HQYLURQPHQWV

r TXDUWHW ZLWK

$OVR VLJQDO LV FRQVLVWHQW ZLWK &

VLJQDO LV FRQVLVWHQW ZLWK 5&22&

LL Table 14 in the VCE Chemistry Data Book WR LGHQWLI\ SHDNV IR
2 DQG & 2 HVWHUV ERQGV



❶ IRU DOO FRUUHFW

(QG RI 6XJJHVWHG $QVZHUV