

0DVWHURSSJDYH L UHJQVN  
YHG +DQGHOVK;\VNROH

/;QQ RJ SHQVMRQVRSSV  
QRUVNH \$6

(Q VWXGLH RP GHW IDNWLNVH O;QQV  
VHOVNDSHQH KYRU OHGHU WDU XW  
SHQVMRQVRSSWMHQLQJ IUD IRC

\*5\$ (NVDPHQVNRGH RJ QDYQ  
0DVWHURSSJDYH L UHJQVN

,QQOHYHULQJVG DWR

9HLOHGHU  
(UOHQG .YDDO

6WXGLHVWHG  
+DQGHOVK;\VNROHQ %, 2VOR

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)RURUG

'HQQH RSSJDYHQ HU VNUHYHW L IRUELQGHOVH PH  
UHJQVND S RJ UHYLVMRQ YHG +DQGHOVKj\VNROHQ  
XWIRUGUHQQGH RJ VSHQQHQQGH 9HG LQQOHYHULQJ  
PHG VWXGLHU 9L KDU EHJJH DUEHLGHW QRHQ nU  
RYHUJDQJHQ IUD DUEHLG WLOEDNH WLO VWXGLHU  
nUHQH Sn +DQGHOVKj\VNROHQ %, KDU WLOIjUW RV  
EUXN IRU L IUHPWLGHQ

6RP DYVOXWWHQQGH VWXGLH YDOJWH YL WHPDHW  
QjGYHQGLJYLV LQWHUHVHUU DOOH PHQ VRP YHG

2SSJDYHQ KDU Y UW XQGHU NRQWLQXHUOLJ YHLO  
.YDDO YHG +DQGHOVKj\VNROHQ %, RJ YL jQVNHU  
YHLOHGQLQJ

6WRU WDNN UHWWHV RJVn WLO \$QWKRQ \$QGUHDV  
VRP KDU KMXOSHW RVV PHG Q\WWLJ LQIRUPDVMRQ  
VLPXOHULQJVPRGHOHQ VRP KDU Y UW YLNWLJ IR

2VOR DXJXVW

\$OH[DQGHU %URQNHQ

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6DPPHQGUDJ

%DNJUXQQHQ IRU RSSJDYHQ HU HQ DUWLNNHO L \$  
IUHPOD HW UHVXOWDW IUD HQ XQGHUV;NHOVH VR  
VHOVND S WDU XW IRU ODY O;QQ RJ GHUPHG OXU  
SHQVMRQVRSSWMHQLQJ 6WXGLHQV IRUPnO HU n  
SHQVMRQVa`WRMHQHWMHHFPFPVnrìQV \Q PFP[<OÀdÐ  
PWRQVa`S VWT \$ÀÀ3 RÀRn€\$À 0SFÁVa`f H @ rœÀL

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,QQKROGVIRUWHJQHOVH

)2525'

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6LGH LLL

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.MjQQ  
/HGHUV DOGHU  
8WE\WWH  
%HOLJJHQKHW  
2SSVXPPHULQJ DY NU\VVWDEHOOHU  
5HJUHV MRQVPRGHOHQ  
0XOWLNROOLQHDULWHW  
5HJUHV MRQVDQDO\H  
+\SRWHVHVHVWLQJ  
/jQQVRPKHW  
6DOJVLQQWHNWHU VWjUUHOVH  
.MjQQ OHGHU  
/HGHUV DOGHU  
+DU XWE\WWH  
%HOLJJHQKHW

.21./86-21(5

(7 %/,... , .5<67\$//.8/(1

.5,7,6.( %/,...

8', (16 % (7<'1,1\*

/,77(5\$785/,67(

9('/(\*\* \$9,6\$57,..(/

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9('/(\*\* ± 3(16-216%(5(\*1,1\*(5 273

7DEHOORYHUVLNW

7DEHOO 2YHUVLNW RYHU YDULDEOHQH L UHJUHVM  
7DEHOO 2YHUVLNW RYHU HQGHOLJ SRSXODVMRQ  
7DEHOO )RUGHOLQJ;DQ YDULDEHOHQ  
7DEHOO (QGHOLJ IRUGHOLQJ;DQ DYKHQJLJH  
7DEHOO 2YHUVLNW RYHU DQWDOO OHGHUH PHG C  
7DEHOO 2YHUVLNW RYHU DQWDOO OHGHUH LQQH  
7DEHOO )RUGHOLQJ Sn LQQWHNVV RJ DOGHUVLC  
7DEHOO 3HQVMRQVRSSWMHQLQJ IUD IRONHWU\JG  
7DEHOO )RUYHQWHW ODQJVLNWLJ UHDODYNDVWQ  
7DEHOO (VWLPHUW XWEHWDOLQJ IUD LQQVNXGGV  
7DEHOO ,OOXVWUDVMRQ DY O;QQ YV PH\ YV34LV4

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,QQOHGQLQJ

+RYHGWHPD IRU GHQQH PDVWHURSSJDYHQ HU SHO





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O;QQVXWWDN IUD VHOVNDSHW \$Y VNWO † I;C  
XWJLIWVJRGWJM;UHOVH QDWXUDO\WHOVHU RJ DN  
PHG L GHQ SHQVMRQVJLYHQGH LQQWHNWHQ 'LVV  
WLO GHQ UHQH O;QQVLQQWHNWHQ IRU n NRPPH IU  
LQQWHNW 'HW HU IDVWVDWW EHO;SVJUHQVHU IRU  
SHQVMRQVRSSWMHQLQJ %HO;SVJUHQVHQ IRU  
VWXGLHQV WHRULGHO

\*UXQQEHO;SHW IUD IRONHWU\JGHQ \*  
\*UXQQEHO;SHW \* HU HQ EHUHJQLQJVIDNWRU VRF  
RJ IRU VW;UUHOVHQ Sn \WHOVHU HWWHU IRONHWU  
UHJXOHUHV nUOLJ 7LO JUXQQ IRU UHJXOHULQJHC  
UHJXOHULQJVnUHW MXVWHUW W W XQ UH 7H  
IRUYHQWHWHU LOH \$Àp0XLOX X 0ð0 W W LOJ P HÀ  
P P \$ÀQ, LUL UP, H@DLW HPÀ O@LW I€UA\$Àq€ð0 P 0MP€

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DUEHLGVSODVVHU KYRU HQ JUX\$&HKDUEEHLJUMVQDNH  
SRSXODVMRQ WLO NXQ n JMHOGH VHOVNDS PHG p  
VPn VHOVNDS 7DULIIDYWDOHU HU OLWH XWEUHG

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SHQVMRQHU LYHUNVHWWHV IUD RJ PHG /HYHD  
SHQVMRQHU VRP WDV XW IUD

3n EDNJUXQQ DY DW SHUVRQHU IjGW L HOOHU  
XWHOXNNHQGH Sn EDNJUXQQ DY GHW Q\H RSSWMH  
XWYDOJ DY EHGULIWVOHGHUH WLO GHQQH DOGHU  
DY VWXGLHQH 'HQQH EHJUHQVQLQJHQ YLO JL DO  
VDPPHQOLJQLQJVJUXQQODJ L IRUELQGHVH PHG  
SHQVMRQVRSSWMHQLQJ IRUGL GH KDU OLNH IRUX  
RSSWMHQHV 'LVVH HVWLDPDWHQH YLO YL SUHVHQ  
IRU XWYDOJ DY EHGULIWVOHGHUH YLO EOL SUHVH

9L YLO LNNH Jn Q UPHUH LQQ Sn GHWDOMHQH L G  
QHYQW RYHQIRU NRQVHQWUHUUHU RVV RP OHGHUH

'H Q\H UHJOHQH

'HW Q\H SHQVMRQVV\VWHPHW E\JJHU Sn IjOJHQGH  
. )OHNVLELOLWHW IRU QnU PDQ NDQ WD XW SHO  
NDQ WDV XW KHOW HOOHU GHOYLV L IUL NRPE  
\WWHUOLJHUH SHQVMRQVRSSWMHQLQJ 'HWWH  
DUEHLGVWDNHUH n MREEH UHGXVHUW RJ WD X  
. '\$OOHnUVRSSWMHQLQJ' PHGIjUHU DW DOOH n  
SHQVMRQVRSSWMHQLQJ RJ ELGUDU WLO DW G  
. /HYHDOGHUVMXVWHULQJ EHW\U DW \QJUH DUE  
VDPPH SHQVMRQ VRP HOGUH DUEHLGVWDNHUH  
EHIRONQLQJHQ jNHU

6HOYH RSSWMHQLQJHQ DY SHQVMRQ HU IDVWVDW  
LQQWHNW RSS WLO HW WDN Sn \* JLU SHQVMRQ  
SHQVMRQVRSSWMHQLQJHQ VXPPHUHV YLGHUH RSS  
EHQ\WWHV WLO n EHUHJQH GHQ HQNHOWHV nUOLJ  
SHQVMRQVEHKROGQLQJHQ GHOHV Sn HW GHOLQJV

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5HJMHULQJHQ  
6WRUHEUDQG

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6LGH

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JnU XW Sn DW DUEHLGVJLYHU nUOLJ LQQEHWDOHU  
HQ HJHQ SHQVMRQVNDVVH IRU SHQVMRQVRUGQLQ  
VRP KDU DQVYDU IRU n IRUYDOWH LQQVNXGGHW I  
DOWVn DY DUEHLGVJLYHU RJ RSSOHYHV LNNH VR  
'HUVRP SHQVMRQVEHKROGQLQJHQ SODVVHUHV L F  
ULVLNRSURILO 5LVLNRSURILOHQ NDQ EHVWHPHV  
'HW VWLOOHV L 273 ORYHQ † MI )RUVNULIW WL  
LQQVNXGGVSHQVMRQ L DUEHLGVIRUKROG † NU  
LQQVNXGG VRP PLQLPXP WLOVYDUHU SURVHQW I  
DUEHLGVWDNHU KDU OjQQ XQGHU \* VNDO GHW L  
LNNH LQQVNXGG IRU DQGHO DY OjQQ VRP RYHUVV  
LQQVNXGG Sn SURVHQW IRU OjQQ PHOORP \* RJ  
\* RJ \*

, GH IOHVWH WLOIHOOHU HU XWEHWDOLQJ  
QRUPDOW nU RJ GHQ WRWDOH SHQVMRQVXW  
LQQVNXGGHW VRP HU DYWDOW DQWDOO LQQVNXG  
RJ DQWDOO nU PHG XWWDN

<WHOVHVEDVHUW WMHQHVWHSHQVMRQ  
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IUHPWLGLJ SHQVMRQVXWEHWDOLQJ KYRU NRPELO  
IRONHWU\JGHQ RJ WMHQHVWHSHQVMRQ IUD DUEH  
OjQQHQ DUEHLGVWDNHU KDGGH YHG SHQVMRQVW  
DQGHOHQ XWJMjU FDHQ \WISORVHEDVHUW SHQVMRQ  
DOWVn EHVWHPW Sn IRUKnQG PHQV SUHPLHQ VRF  
DY DOGHU RJ NMjQQ 3n GHQQH PnWHQ SnYLUNHV  
DUEHLGVWDNHU DY KYRUGDQ GHQ HQNHOWH KDU  
WMHQHVWHSHQVMRQ DOGUL VDPRUGQHW PHG \WH  
XWEHWDOLQJ YHG SHQVMRQVDOGHU %nGH LQQVN  
SULYDW VHNWRU JnU GHUIRU VHPVQH WQVHSHQVMRQ  
\WHOVHVEDVHUW SHQVMRQVRUGQLQJHQ LNNH ND  
SHQVMRQV\WHOVHQ LQNOXGHUW IRONHWU\JGHQ

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1RUVN 3HQVMRQ  
6WRUHEUDQG  
)LQDQV 1RUJH

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IUHPODJW L SHQVMRQVSODQH Q HNVHPSHOYLV  
OHJJHU WLO JUXQQ HQ EHUHJQHW IRONHWU\JG S  
RUGQLQJHQ (WWHUVRP RUGQLQJHQ LNNH VDPRUC

VY LL

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QDVA@HURSSJDYH \*5\$HUDVDY DOJì

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XRGHUV;NHOVHQ XWI;UW DY )DIR YLVHU GHQQH D  
 DDYDVAH P HOORP RJ KDU HWDEOHUW HQ  
 KDU HWDEOHUW HQ UHWQWVHIOU HRWRUIGGLQNDVMRQH  
 LQQVNXGGVPRUGQLQDYQLHU @A@LPHAW XWEDHGW  
 Y ,DULV

V IÀL2SDV@MO B@M,FR U L J D  
 GRP QHYQW LD @DHGQLS@PÀYQLVDEOHH`Y@ M@LPJEW PW  
 VHWW RSS PRW SHQVMRQVRSSWMHQLQJ HWWHU D







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/iQQVIRUVNMHOOHU PHOORP NMiQQ

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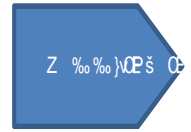
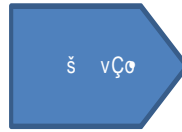
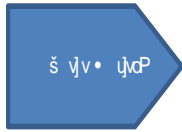
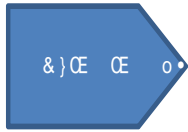
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6LGH

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'H XOLNH VWHJHQH L IRUVNQLQJVSURVHVH HQ NDQ  
ILJXU



,Ⓟ WHPD

3UREOHPVWLOOLQJ

/LWWHUDWXUJMHQQRPJQJ

)RUVNQLQJVGHVLIJQ

9DOJ DY PHWRGH

8WYDOJ

'DWDLQQVDPOLQJ

'DV

)LJXU

2YHUVLNW RYHU IRUVNQLQJVSURVHVH HQ

)LJXU

YLVHU HQ RYHUVLNW RYHU IRUVNQLQJVSURVHVH HQ

PHUNH VHJ DW IRUVNQLQJVSURVHVH HQ HU HQ NRQ

VWHJHQH L VWRU JUDG JOLU LQQ L KYHUDQGUH S

KYHU IRU VHJ PHQ YLO KHOOHU SUHVHQWHUH IRU

)RUEHUHGHOVH

)RUVNQLQJVDUEHLGHV WVDUWHU VRP UHJHO PHG

ODQ YHOJHU VHJ HW HPQH RJ IRUViNHU n XWDUEH

GHWWH HPQHW 3UREOHPVWLOOLQJHQ E;U Y UH V

SUREOHPVWLOOLQJ VRP GHV YLO Y UH PXOLJ n N

JM;UH VHJ HQ WDQNH RP KYRUIRU GHV HU Q\WWL

KYHP VRP NDQ GUD Q\WWH DY GHV

,QQHQ IRUVNQLQJ NDQ PDQ VL DW GHV HU WR PnV

HQ NRQNOXVMRQHU S n QG XNWLY PHWRGH HU EDVH

EHYLV PHQV GHGXNWLY PHWRGH HU EDVHUW Sn C

JHQHUDOLVHUHQGH NRQNOXVMRQHU Sn EDNJUXQQ

Sn EDNJUXQQ DY GHWWH VHWWH RSS I;OJHQGH VD

! WHRUL 9HG GHGXNVMRQ NDQ PDQ Sn HQ HQNHQ

.YDDO

6LGH



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IHQRPHQHW UHODWLYW NODUH K\SRWHVHU RP KY  
KYHUDQGUH RJ WLO VOXWW HQ GHILQHUW SRSXO

9L YLO EHQ\WWH GHVNULSWLYW GHVLJQ IRU n ILQ  
XOLNH VHOVNDSHQH RJ KYRU P\H GH XOLNH OHGH  
SHQVMRQVRSSWMHQLQJ 9L ;QVNHU YLGHUH n ILQ  
GH VHOVNDSHQH KYRU OHGHU WDU XW O;QQ RYHU  
SUHJ DY NDXVDOW GHVLJQ GD YL KDU VRP VLNWH  
XOLNH IDNWRUHU YDULDEOHU RJ OHGHUO;QQHQ  
NRUUHODVMRQHU PHOORP EDNHQIRUOLJJHQGH ID  
EHQ\WWH RVV DY HQ 5HHJWHHWMRQWDDDD\WHH RJ GH  
UHJUHVMRQVPRGHOHQ EOLU Q UPHUH IRUNODUW

'DWDLQQVDPOLQJ

'HW VNLOOHV PHOORP WR W\SNVDFHMRQWVRLW DW  
PHWRGH .YDOLWDWLY PHWRGH EHQ\WWHV RIWH L  
SUREOHPVWLOLQJHQ HU nSHQ (Q NYDOLWDWLY W  
NDDQW WDWY YW CAQHER LQEL@RGSELO.PREQPNS Q QPANEW  
@APPLE A C WLO P A A W P G A Y W L Q @ A A A n c @ Z L Q Q L Q Q L Q  
@APPLE A C WLO P A A W P G A Y W L Q @ A A A n c @ Z L Q Q L Q Q L Q





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9DOLGLLWHW

9DOLGLLWHW HU HQ EHWHJQHVVH Sn KYRU JRGW P  
XQGHUV;NH 5HOLDELOLWHW HU HQ EHWLQJHOVH  
JLU JUXQQODJ IRU n SnVWn DW VDPHQKHQJHQ V  
9DOLGLLWHW NDQ VSOLWWHV L LQWHUQ YDOLGLLWH

,QWHUQ YDOLGLLWHW VLHU RP VDPHQKHQJHQ HU  
YDOLGLLWHW VLHU RP VDPHQKHQJHQ L XWYDOJHV

8WYDOJ SRSXODVMRQ

9nU SUREOHPVWLOOLQJ HU NQ\WWHW WLO SHQVM  
\$6 'DWDILOHQ YL KDU PRWDDWW IUD &&\*5 GDWDE  
UHJQVNDVGDWD KHQWHW IUD QRUVNH \$6 IUD  
GDWDJUXQQODJHW 6RP QHYQW L NDSLWWHO WU  
DOGHUVSHQVMRQ IUD IRONHWU\JGHQ L NUDIW L  
UHJQVNDVWDOO IUD VOLN DW YL NDQ EHQ\WV  
EHUHJQLQJHU 9nUW GDWDJUXQQODJ Pn GHUIRU L  
PHG UHJLVWUHUWH UHJQVNDVWDOO IRU 9L  
VRUWHUH RJ DQDO\VHUH GDWDHQH YnUH 6366 HU  
VRUWHUW Sn VHOVNDVW\SH ©\$6<sup>a</sup> RJ UHJQVNDSV  
GDWDJUXQQODJ Sn VHOVNDV

9L ;QVNHU n EHNUHIWH DW GDWDHQH VRP HU OHV  
PXOLJ \$OWVn DW GHW LNNH HU UHJLVWUHUW VHC  
UHJLVWUHUW L &&\*5 GDWDEDVHQ 3n QHWWVLGHQ  
LQIRUPVMRQ RP KYRU PDQJH QRUVNH \$6 WDPG U  
QRUVNH \$6 SU HU L I;OJH WDEHOHQ  
&&\*5 HU )RUVNMHOHQ PHORP &&\*5 RJ )R  
KDU UHJLVWUHUW LQQVHQGW UHJQVNDVVLQIRUPD  
PHQV )RUHWDNVUHJLVWUHUW KDU UHJLVWUHUW D  
IUD QHWWVLGHQH WLO )RUHWDNVUHJLVWUHUW YL  
9L KDU Y UW L NRQWDNW PHG )RUHWDNVUHJL

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.YDDO  
)RUHWDNVUHJLVWUHUW

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Q\UHJLVWUHUWH VHOVNDS KDU HQ ©RSSVWDUWVS  
nUVUHJQVNDS LNNH Pn VHQGHV LQQ L RSSVWDUW  
HQQ VHNV PnQHGHU IjU MI UHJQVNDSVORYH  
ÀPHNN †VRVNÀ0H VHLHQGHVNQS€J0QGHQ QGU•P@

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'DJOLJ OHGHUV IjGVHOVnU

.XQ VHOVNDS PHG GDJOLJ OHGHU IjGW L HOOH  
IjGW L HU nU L XQGHUVjNHOVHVnUHW 9  
IRU DW SRSXODVMRQHQ NXQ VNDO LQQHKROGH VH  
SHQVMRQ HWWHU GH Q\H RSSWMHQLQJVUHHJOHQH

6DOJVLQQWHNWHU

.XQ VHOVNDS PHG VDOJVLQQWHNW Sn NU HO  
'HWWH HU HW IRUVjN Sn n XWHOXNNH VHOVNDS V  
HLHQGRP VXWOHLH HWF RJ VHOVNDS VRP LNNH  
\* 9L EHUHJQHU VDOJVLQQWHNW Sn FD NU  
DQGUH NRVWQDGHU HQQ OjSHQGH GULIWVNRVWQD  
GULIWVNRVWQDGHU XWJMjU FD DY VDOJVLQQ  
HWWHU XWWDN DY OjQQ 'HW OHJJHV WLO DUEHLC  
JUXQQODJ L \* IRU Sn JLU GHWWH VDOJVL  
UXQGHV RSS WLO NU

, IjOJH UHJQVND SVORYHQ † LQQHKROGHU UHVX  
DQQHQ GULIWVLQQWHNW 'LVVH WR WLO VDPHQ  
DQGUH GULIWVLQQWHNWHU NDQ Y UH OHLHLQQWH  
DQOHJJVPDVNLQHU 9HG YnU XWVLOLQJ DY VHOVN  
LQNOXGHUW DQGUH GULIWVLQQWHNWHU 'HWWH I  
PHG L VWXGLHQ IRUGL GH HNVHPSHOYLV KDU VRO  
XW

5HOLDELOLWHWVNRQWUROO DY GDWDJUX

)jU YL EHJUHQVHU GDWDJUXQQODJHW PHG YDULD  
UHOLDELOLWHWHQ L GDWDJUXQQODJHW YL KDU W  
XWYDOJHW YL IRUHWDU VHQUH HU EDVHUW Sn N  
JMHQQRPIjUH YHG n SOXNNH XW WLOIHOGLJH V  
VHOVNDS L &&\*5 RJ NRQWUROOHUH LQIRUPDVMRC  
PRW RSSO\VQLQJHU L 3URII )RUYDOW 3n GHQQH P  
HQKHWHU VRP VNDO Y UH PHG L SRSXODVMRQHQ Y  
RSSO\VQLQJHQH L &&\*5 GDWDEDVHQ HU IHLODNWL  
GDJOLJ OHGHU VRP HU IjGW L LNNH NRPPHU P

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6LGH

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GDWDEDVHQ LQQHKROGHU IHLODNWLJH RSSO\VQL  
8WYDOJHW IRUHWDV YHG n SOXNNH XW HQKHW  
IXQVMRQ PHG WLOIHOGLJ XWYDOJ L 6366

5HVXOWDWHW DY UHOLDELOLWHWVNRQWUROOHQ  
HQNHOWH WLOIHOOHU DYGHNNHW GLIIHUDQVH PH  
'HW HU YLNWLJ n PHUNH VHJ DW &&\*5 SUHVHQWHU  
BURIO )RU YOHVW AK @L RSPG DEW BRW HHAHQH QUPDVM  
VN\OGHV DW GHW HU IRUHWDWW HQGULQJHU L HL  
DYVLN KRV VHOVND S L XWYDOJHW PHG HLHUH H  
VW;UUH VHOVND S PHG IOHUH HLHUH RIWHUH IRUH  
XWYDOJHW PHG HLHU VWHPWH HLHURSSO\VQLQJ  
VWHPWH RJVn KRV VHOVND S PHG HLHUH HOOHU  
IRU DW RSSO\VQLQJHQH VRP HU JLWW L &&\*5 HU S  
EHJUHQVQLQJHQ DY SRSXODVMRQH Q RJ XWYDOJH

3UHVHQWDVMRQ DY YDULDEOHU VRP YLO EOL E  
(WWHU DW YL KDU VWXGHUW OHGHUQH V O;QQVQL  
YLO YL IRUV;NH n IRUNODUH KYD VRP NMHQQ  
W DU XW O;QQ RYHU \* )RU n VWXGHUH GLVVH H  
UHJUHVMRQVDQDO\VH (Q UHJUHVMRQVDQDO\VH E  
DYKHQJLJ YDULDEHO RJ HQ HOOHU IOHUH XDYKHQ  
DYKHQJLJH YDULDEHOHQ Y UH GLNRWRP IRUGL GH

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NXUYHIRUP /iQQVXWWDN IRUYHQWHV n VWLJH PH  
IRUYHQWHV n DYWD QnU OjQQVRPKHWHQ QnU HW  
UHJUHVMRQ DW IjOJHQGH IRUXWVHWQLQJHU HU R  
6DQQV\QOLJKHWHQ HOOHU DQGHQH DQW  
XDYKHQJLJH YDULDEOHU  
2EVHUYDVMRQHQH DY GHQ DYKHQJLJH YD  
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XWYDOJ DY HQKHWHU  
9L Pn LNNH KD VWHUN PXOWLNROOLQDULV  
VWHUN OLQH U VDPHQQKHQJ PHOORP WR  
YDULDEOHQH L PRGHOHQ

)RUXWVHWQLQJ RJ DQWDV n Y UH RSSI\OW L Yn  
YLO YL WHVWH QnU YL NRPPHU WLO IRUVWnHOVH  
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SUHVHQWHUH GH YDULDEOHQH VRP OLJJHU WLO J

\$YKHQJLJ YDULDEHO ± OHGHUOjQQQLQJHU  
'HQ DYKHQJLJH YDULDEHOHQ L PRGHOHQ HU QLY  
~~DÀ MÈNÈMÈ MÈI; RÈUÈ DEJHÈTÈ QÈ HÈTÈ VÈRÈ YÈRÈUÈ VÈMÈO @ QÈ~~  
,È QÈDUY nLI,ÈO HÈMÈÀ , Q VnHDnHÈHPÈ H @ÈLHÈTÈR L

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VHOVNDSHWV LQQWHNDVCHV LRJQQMHGHWUHQOLi QH J VHO  
GLUHNWH LQQYLUNQLQJ Sn OHGHUV OjQQVXWWDN  
VHOVNDSHWV VWjUUHOVH +j\HUH VDOJVLQQWHNV  
GHW Y UH HQ VDPHQQKHQJ PHOORP VHOVNDSHWV

+ )RUHWDN PHG Kij\H VDOJVLQQWHNWHU KDU VWj  
OHGHUOjQQ HQQ IRUHWDN PHG ODYHUH VDOJVLQQ

/HGHUV NMjQQ

)RUVNMHOOVEHKDQGOLQJ PHOORP PDQQOLJH RJ M  
XWVODJ L XOLN OjQQ HU HW WHPD VRP RSSWDU  
YDU GHW VOLN DW NYLQQHU L JMHQQRPVQLWW W  
WMHQWQ VDPH WHQGHQVHQ YLVHV L XQGHUVjNH  
KYRU GHW NRPPHU IUHP DW NYLQQHOLJH OHGHUH  
WLO PDQQOLJH OHGHUH /jQQVIRUVNMHOOHQH ND  
Y UH VOLN DW NYLQQHU YHOJHU \UNHU VRP JLU O  
WLPHU VRP IjOJH DY VYDQJHUVNDSVSHUPLVMRQ R  
RYHUWLGVDUEHLG XOLNH NYDOLILNDVMRQHU R O  
L YnU PRGHOO 'HW YL jQVNHU n ILQQH VYDU Sn H  
VDPHQQKHQJ PHOORP OHGHUV NMjQQ RJ OHGHUV

%XJHMD HW DO VLQ VWXGLH IUD NRQNOXGHU  
VDPHQQKHQJ PHOORP OjQQ IRU &(2 RJ KYRUYLGW  
IOHUH DY VWXGLHQH GH EDVHUHU VHJ Sn NRQNOX  
VDPHQQKHQJ \*HQHUHOW YLVHU XQGHUVjNHOVHU  
NYLQQHUV OjQQVQLYn OLJJHU ODYHUH HQQ OjQQY

%DVHUW Sn VWXGLHQH YL KDU JMHQQRPJnWW IRU  
EHGULIWVOHGHUH WDU XW ODYHUH OjQQ HQQ PDC

+ )RUHWDN PHG PDQQOLJ OHGHU KDU VWjUUH WL  
OHGHUOjQQ HQQ IRUHWDN PHG NYLQQHOLJ OHGHU

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5DQGj\ RJ 1LHOVHQ  
6WDWLVLVNLN 6HQWUODOE\Un

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6LGH

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\$QWDOO DQVDWWH

(W ;NHQGH DQWDOO DQVDWWH YLO Sn HW JHQUH  
EHGULIW PHG PDQJH DQVDWWH YLO GH DQVDWWH  
O;QQVIRUKDQGOLQJHU HQQ GHW PDQ YLO KD L PL  
GULYHV RSSRYHU )OHUH DQVDWWH PHGI;UHU YLG  
DQWDOO DQVDWWH RJ VW;UUH RPIDQJ DY GULIWH  
8QGHUV;NHOVHQ WLO 1RUVN /HGHOVHVEDURPHWH  
PHG ;NHQGH DQWDOO DQVDWWH 8QGHUV;NHOVHQ  
SDQHO RJ HU EHGULIWHU VRP KDU VDJW VHJ YLO  
8QGHUV;NHOVHQ HU VnOHGHV LNNH UHSUHVHQWD  
SDQHOHWV PHGOHPPHU VRP HU XQGHUV;NW 9L V  
LQWHUHVVDQWH RJ ;QVNHU n VH RP GHWWH RJVn

+ )RUHWDN PHG IOHUH DQVDWWH KDU VW;UUH W  
HQQ IRUHWDN PHG I UUH DQVDWWH

/HGUV I;GVHOVnU

3n HW JHQUHOW JUXQQODJ YLVHU O;QQVVDWL  
K;\HUH DOGHU I;UHU WLO K;\HUH O;QQ 6WDWLWV  
nUV DOGHU PHQV ;NQLQJHQ 'HODWHVPHWL XWLN  
DOOH KHOWLGVDQVDWWH L 1RUJH L RJ IDYQH  
JM;U LPLGOHUWLG DW YL ;QVNHU n VH RP GHWWH  
VHOVNDSHQH YL XQGHUV;NHU 8WRYHU GHWWH ND  
OHGHU PHG ;NHQGH DOGHU RJ NRUWHUH WLG WLO  
HQQ HQ \QJUH OHGHU PHG OHQJUH WLG WLO SHQV  
L XQJ DOGHU DW PDQ NDQ WUHQJH PHU SHQJHU 9  
HWDEOHULQJVIDVHQ L OLYHW PHG NM;S DY KXV E  
HOOHUV WLOODWHU GHW 9L ;QVNHU GHUIRU n VH  
SnYLUNHU OHGHUO;QQHQ L VHOVNDSHW

+ )RUHWDN PHG HOGUH OHGHUH KDU VW;UUH WLOE;\HOLJK  
IRUHWDN PHG \QJUH OHGHUH

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6WDWLWLVN 6HQWUOE\Un

6LGH



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8WE\WWH

/iQQ RJ XWE\WWH UHSUHVHQWHUHU GHW DNVMRQ  
OjQQ EOLU GHW PLQGUH LJM HQ WLO XWE\WWH RJ  
HU RPWDOW RYHU EOH IjOJHQGH K\SRWHVH IRUPX

’, VHOVND SHU VRP EHWDOHU XW P\H XWE\WWH HU  
VRP EHWDOHU XW PLQGUH L XWE\WWH ’

8QGHUVjNHOVHQ EOH VRP WLGOLJHUH QHYQW XW  
LQQIjUW VNDWW Sn XWE\WWH 'H XOLNH OHGHUQH  
WLO n WD XW XWE\WWH IUHPIRU OjQQ HQQ VOLN V  
EHNUHIWHW RJ HQ NXQQH LNNH VL DW Kj\HUH XW  
OjQQ 9L jQVNHU n VH YLGHUH Sn IXQQHW IUD GH  
IRUPHQLQJ RP DW OHGHUQH L GH VHOVND SHQH KY  
VRP WDU XW Kj\HVW OjQQ DOWVn PRWVDWW DY G

+ )RUHWDN PHG XWEHWDOLQJ DY XWE\WWH KDU V  
OHGHUOjQQ HQQ IRUHWDN VRP LNNH XWEHWDOLQJ

%HOLJJHQKHW

8QGHUVjNHOVHQ WLO 1RUVN /HG HUEDURPHWHU YI  
OjQQVIRUVNMHOOHU PHOORP I\ONHQH 2VOR VNLQ  
JMHQQRPVQLWWOLJ OHGHUOjQQ 6RJQ RJ )MRUGD  
IjOJHU Q UPHVW 9L jQVNHU n XQGHUVjNH RP VHO  
Sn VDQQV\QOLJKHWHQ IRU DW HQ OHGHU L YnU SF  
IRUHQNOH DQDO\VHQH jQVNHU YL n VH Sn 2VOR R

+ )RUHWDN L 2VOR RJ \$NHUVKXV KDU VWjUUH WL  
OHGHUOjQQ HQQ IRUHWDN ORNDOLVHUW L UHVWH

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2YHUVLNW RYHU YDULDEOHU

7DEHOO 2YHUVLNW RYHU YDULDEOHQH L UHJU  
1DYQ Sn YDULDEHO ERUONODULQJ 'HILQLVMRQ NRGLQJ

/HGHUO;QQ DYK;QQXWWDN IRU O;QQXQGH  
YDULDEHO KYHU HQNHOW EHG;QQ RYHU \*

\$YNDVWQLQJ 6HOVNDSHWV nUVUHVXOWDW L  
IRUKROG WLO W  
L

6W;UUHOVH 6HOVNDSHWV VI

/HGHUV NM;QQ /HGHUV NM;QQ NYLQQH PDQQ

\$QWDOO DQVDW;YRU PDQJH DQVDW;YRU DQVDW;YRU  
VHOVNDSHW HOOHU IOHUH DQ  
XWRYHU GDJOLJ OHGH

/HGHUV I;GVHOV;YRU HU OHGHU I;GW  
RVY

8WE\WWH 6HOVNDSHW KDU KDU UNLN;YRU  
XWE\WWH L KDU XWE\WWH

%HOLJJHQKHW 6HOVNDSHW KDU W;YRU  
2VOR \$NHUVKXV H;YRU  
UHVWHQ DY ODQGHW

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8QGHUV;NHOVHQ

, GHWWH NDSLWWHOHW YLO YL IRUHWD HQ HQGH  
SUHVHQWHUH IXQQHQH YL KDU JMURW L YnU VWXC

\$YJUHQVQLQJ DY SRSXODVMRQH

OnOJUXSSHQ IRU YnU XQGHUV;NHOVH HU QRUVNH  
LQQHKDU HQ OHGHUSRVLVMRQ L VHOVNDSHW 9L  
GDWDJUXQQODJHW Sn VHOVNDSHU IRU n In  
SRSXODVMRQH 8WYDOJVNULWHULHQH XW RYHU  
DYVQLWW

7RWDOW @!ZPH@!UNW RYHU HQGHOLJ SRSXODVM

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7RWDOW GDWDJUXC

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RP OHGHUO;QQ VRP HU YnU DYKHQJLJH YDULDEH  
DYVLN L UHOLDELOLWHWVNRQWUROOHQ VRP HU S

6RP JUXQQODJ IRU XQGHUV;NHOVHQ VWnU YL Qn L  
VHOVNDS 'HW I;UVWH YL ;QVNHU n JM;UH HU n VN  
REXHUYDVMRQHQH L SRSXODVMRQHQ 'HQ I;UVWH  
NXQ GHQ DYKHQJLJH YDULDEHOHQ OHGHUO;QQ R  
JMHQQRPI;UHV YHG GHVNULSWLY VWDWLVLWLN 7  
GHQ DYKHQJLJH YDULDEHOHQ LQQHQIRU SRSXODV  
XDYKHQJLJH YDULDEOHQH

7DEHOO )RUGHOLQJ DY YDULDEHOHQ OHGHUO;

	\$QW	DOO	LQLP	XP	ODNVLP	X	MHQQR	F	VQLW	W	6	WDQGDU
/HGHUO;QQ												
7RWDOW												

6RP YL VHU DY WDEHOO YLVHU DQDO\|VHQ HQ P  
NU VRP YLUNHU ULPHOLJ 0DNVLPXPVREXHUYDV  
SRSXODVMRQHQ YLVHU VHJ n Y UH NU 'H  
HQ REXHUYDVMRQ 6WDQGDUGDY 6MNDHQG DRUSU DYDLN  
HW PnO Sn KYRUGDQ GH XOLNH REXHUY'DVMRQHQH  
ILQLQHWHLVNH Q

HPDJE

A PWD SD ON

3HEDH 3HNNH

HPHU 3HNNDHU

€P H U3D H U  
DNDHUD Q H

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VHWW RSS L PRW ;YULJH RSSO\VQLQJHU VRP VDO.  
RJ 3URII )RUYDOW YLUNHU NU PHU ULPHOLJ  
REXHUYDVMRQH IUD SRSXODVMRQH )RU n XQQ.  
VNDO JL IHLODNWLJH DQDO\VHUVXOWDWHU IRUH  
REXHUYHUWH OHGHUO;QQQJHU RYHU NU  
ILOWHU L GDWDVHWWHW L 6366 IDQW YL pQ REVH  
YDU HQ REVHUYDVMRQ Sn NU .RQWUROOH  
UHJLVWUHUWH O;QQHQ YDU 'HWWH YLUNHU  
GHUIRU RJVn IMHUQHW IUD SRSXODVMRQH 'HW  
VDQQV\QOLJH IHLO L GDWDJUXQQODJHW LNNH UH  
QRUPDOHQ , VOLNH WLOIHOOHU NDQ GHW VW;WW  
GDWDJUXQQODJHW

(QGHOLJ SRSXODVMRQ

(WWHU n KD IRUHWDWW DYJUHQVQLQJ DY SRSXOD  
WLOIHOGLJ UHOLDELOLWHWVNRQWUROO RJ IMHUQ  
PHG HQ SRSXODVMRQ Sn VHOVNS 7DEHOO  
HJHQVNDSHQH WLO REVHUYDVMRQHQH L SRSXODV

7DEHOO (QGHOLJ IRUGHOLQO D D Y H G H Q Q D Y K H Q J L

	\$QW	DOOOLQLP	XP 0DNVLP	*MHQQR	FVQLW W 6WDQGDU
/HGHUO;QQ					
7RWDOW					

6RP YL VHU DY WDEHOO YLVHU DQDO\VHQ IRUW  
OHGHUO;QQHQ Sn NU RJ HQ PDNVLPXPVREXHUYD  
\*MHQQRPVQLWWOLJ OHGHUO;QQ HU NU RJ V  
6WDQGDUGDYLLNHW LQGLNHUHU Qn DW REVHUYDV  
KYHUDQGUH RJ DW SRSXODVMRQHQH HU IUL IRU RE

\$OGHUVSHQVMRQ IUD IRONHWU\JGHQ  
)iUVWH GHO DY YnU SUREOHPVWLOOLQJ EHVWnU D  
GHQQH GHOHQ DY DQDO\VHQ HU n GHOH GHQ HQG

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OjQQVLQWHUYDOOHU IRUHW EHUHJQLQJHU DY D  
LQWHUYDOOHQH RJ GHUHWWHU NQ\WWH GLVVH L  
SHQVMRQVRSSWMHQLQJ IUD IRONHWU\JGHQ 9L jQ  
SHQVMRQVRSSWMHQLQJHQ EODQW OHGHUQH LQQH  
GHQQH DQDO\VHQ Sn IjOJHQGH PnWH

)RUGHOH SRSXODVMRQH L HQKHWHU P

)RUGHOH SRSXODVMRQH Sn IjOJHQGH

D NU ± NU

E NU ± NU

F NU ± NU

G NU ± NU

H NU ± \*

I RYHU \*

)RUGHOH LQQWHNVVLQWHUYDOOHQH Sn

)RUHW EHUHJQLQJHU DY SHQVMRQVRS

LQQWHNVVLQWHUYDOOHQH RJ DOGHUVWU

6DPPHQOLJQH UHVXOWDWHW DY GHQ GH

EHUHJQLQJHQH DY SHQVMRQVRSSWMHQLQ

/HGHUOjQQ RYHU XQGHU \*

6RP QHYQW L NDSLWWHO HU PDNVLPDO EUXWWR

\* 'HWWH WLOVYDUHU NU SU PDL , WD

RSS L VHOVNS KYRU OHGHU WDU XW OjQQ XQGHU

7DEHOO 2YHUVLNW RYHU DQWDOO OHGHUH PHG

	\$QW	DOO 3URV	HQW
/HGHUOjQQ XQGHU	*		
/HGHUOjQQ RYHU	*		
7RWDO			

7DEHOO YLVHU DW DY OHGHUQH L SRSXOD

GHQ SHQVMRQVJLYHQGH JUHQVHQ \*URYW VHWW Y

VRP LQQJnU L YnU XQGHUVjNHOVH LNNH RSSQnU I

OjQQVXWWDN

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/HGHUO;QQ LQWHUYDOOHU

)RUGHOLQJHQ XQGHU RYHU \* JLU HW JURYW EL  
JUXQQODJ IRU n DQVOn KYRU P\H GH HQNHOWH OH  
SHQVMRQVRSSWMHQLQJ 9L ;QVNHU GHUIRU n GHQ  
LQQWHNWLQWHUYDOOHU IRU n GDQQH HW EHGUF  
XQGHUV;NHOVHQ 9L KDU YDOJW n VSOLWWH SRSX  
7DEHOO YLVHU IRUGHOLQJHQ DY DQWDOO OHG

7DEHOO 2YHUVLNW RYHU DQWDOO OHGHUH LQQ

/HGHUO;QQ	\$QWDOO3URV	HQW
8QGHU		
2YHU *		
7RWDO		

7DEHOO YLVHU DW GHW HU VWRU VSUHGQLQJ L  
HQ OHGHUO;QQ XQGHU NU 'HW HU DY  
RJ VRP WDU XW OHGHUO;QQ RYHU \*

)RUGHOLQJ DY O;QQVLQWHUYDOOHQH Sn  
3HQVMRQVRSSWMHQLQJ IUD EnGH IRONHWU\JGHQ  
DUEHLGVWDNHUV JMHQY UHQGH \UNHVDNWLYH ND  
HVWLPHUH IUHPWLGLJH SHQVMRQV\WHOVHU L QHV  
WLO DOGHU L EHUHJQLQJHQH 9L ;QVNHU GHUIRU  
PHG KHQV\Q Sn DOGHUVWULQQ 'HWWH IRU n NXQQ  
LQQHQIRU KYHUW O;QQVLQWHUYDOO 3n GHQQH P  
O;QQVQLYn PHG GHQ HVWLPHUWH SHQVMRQV\WHO  
WDEHOO L YHGOHJJ 7DEHOO QHGHQIRU RSS  
2SSVXPPHULQJHQ YLVHU OHGHUH L nUV DOGHUH  
nU





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VRP HU ODJW IUHP L IR\$ÅÅ



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VLYLOVWDWXV EHW\GQLQJ IRU XWEHWDOLQJHQ ,  
VLYLOVWDWXV VRP PHGI;UHU DW PRGHOHQ EHUH  
RUGLQ U VDWV 9L KDU VRP WLGOLJHUH QHYQW O  
KDU VDPERHUH RJ GHW EHUHQHV I;OJHOLJ JDUD

%HUHQJLQJ DY DOGHUVSHQVMRQ IRU LQQWH  
9HG KMHOS DY VLPXOHULQJVPRGHOHQ KDU YL IR  
SHQVMRQ IRU VDPWOLJH DOGQLQLJ OHQVMRQ DOV

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IRUHWDDWW GD YL PHQHU GHW JLU VDPPH HIIHNW  
7DEHOOHQ YLVHU EODQW DQQHW DW HQ OHGHU V  
OjQQVLQQWHNW YLO In XWEHWDOW NU IUD I  
VDPPHQOLJQLQJ YLO HQ nU JDPPHO OHGHU XWH  
\$W XWEHWDOLQJHQ HGGUHV PHG OHGHUHQV DOGH  
IRU n EHUHJQH nUOLJ XWEHWDOLQJ jNHU JUXQQH  
YLVHU WDEHOOHQ HNVHPSHOYLV DW HQ nU JDP  
SHQVMRQVXWEHWDOLQJ IUD IRONHWU\JGHQ PHG K  
YHG n jNH VLWW OjQQVXWWDN IUD NU WLO I

6DPPHQOLJQH UHVXOWDWHW DY GHQ GHV  
EHUHJQLQJHQ DY SHQVMRQVRSSWMHQLQJ  
7DEHOO YLVHU DW OHGHUH VRP YHOJHU n LNNI  
P\H VRP NU nUOLJ L DOGHUVSHQVMRQ IUD I  
VWRU LQQYLUNQLQJ Sn IUHPWLGLJ XWEHWDOLQJ

'HUVRP YL VHU WDEHOO RJ WDEHOO L VDPP  
OHGHUH IUD YnU SRSXODVMRQ WDU XW OjQQ  
VWHG PHOORP NU nU OjQQVXWWDN NU  
OjQQVXWWDN L nUOLJ SHQVMRQ +HOH DY GL  
GHUPHG HW VWHG PHOORP NU RJ NU L  
DY OHGHUQH WDU XW OjQQ RYHU JUHQVHQ Sn  
DOGHUVSHQVMRQ L

\*MHQQRPVQLWWOLJ OjQQ IRU DOOH KHOWLGVDQV  
OHG JUXQQODJ L WDEHOO VHU YL DW HQ  
WDSHU HW VWHG PHOORP NU RJ NU L nU  
DOGHU 7DEHOO YLVHU DW DY OHGHUQH L  
OjQQVLQWHUYDOOHV VRP RPIDWWHU GHQQH JMHQ

2EOLJDWRULVN WMHQHVWHSHQVMRQ  
, DYVQLWW RP UHOLDELOLWHWVNRQWUROO D

ÀpU LO LOHE OE Q E@ ...P@ 'ÀPPDW, ð L'up

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6LGH

OjPðj À @ðÀEH L vi° Â/6WWE L 0 6

WQD6 D6ÀPX €PE

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WDEHOO L YHGOHJJ )RU GLVVH VHOVNDSHQH  
KDU 273 VSDULQJ HOOHU LNNH )RU VHOVNDSHU V  
DOOLNHYHO KDU RSSUHWWHW 273 RUGQLQJ HU G  
)RUYDOW VRP RSSO\VHU RP SHQVMRQVRUGQLQJHQ  
RSSJLWW L HJHQ LQIRUPDVMRQVOLQMH KYRUYLGV  
GLVVH VHOVNDSHQH KDU YL NRQWUROOHUW DQWD  
UHJQVNDSHW 3n EDNJUXQQ DY GHQQH LQIRUPDM  
NRQWUROOHUWH VHOVNDSHQH KDU HQ HOOH  
LNNH L VWDQG WLO n LQQKHQWH GHQQH LQIRUPD  
PHQHU OLNHYHO DW YnUW WLOIHOGLJH XWYDOJ S  
KYRUGDQ VLWXDVMRQH HU L YnU SRSXODVMRQ

0HG EDNJUXQQ L RSSO\VQLQJHU RP DW PDMRULWH  
V\QHV n KD HWDEOHUW HQ WMHQHVWHSHQVMRQVF  
EHUHJQLQJHU DY HVWLPHUW IUHPWLGLJ XWEHWD  
DOGHUVSHQVMRQ 3n GHQQH PnWHQ InU YL IUHP H  
HYHQWXHOOH SHQVMRQVWDSHW OHGHUQH L YnU S  
7MHQHVWHSHQVMRQVRUGQLQJHQ NDQ Y UH EnGH  
LNNH L VWDQG WLO n NRQWUROOHUH KYRUGDQ GH  
NDSLWWHO RPWDOWH YL HQ XQGHUV;nHOVH VRF  
XQGHUV;nHOVH XWI;UW DY 2SLQLRQ 3HUGXFR 'LV  
DY PLQGUH \$6 KDU LQQVNXGGVEDVHUW SHQVMRQ  
L GHWWH YLO YnUH EHUHJQLQJHU DY IUHPWLGLJ  
LQQVNXG ~~WMEHQH~~UWHSHQVMRQ PHG IODWW VSD

(VWLPHULQJ DY IUHPWLGLJ SHQVMRQV\WH

%HUHJQLQJVPRGHOHQ IRU 273

6RP QHYQW L DYVQLWW KDU YL Y UW L NRQV  
1RUJH RJ )12 IRU n In WLOJDQJ WLO VLPXOHULQJV  
XOLNH SHQVMRQVDNW;UHQH SHQVMRQVNDONXOD  
KHQV\QWU LPLGOHUWLG LNNH 273 VSDULQJ 3n 6  
WLOJDQJ WLO HQ SHQVMRQVNDONXODWRU VRP RJ  
NRQWDNW PHG %M;UQ (ULN 6 WWHP KRV 6WRUHEU  
KYLONH IRUXVHWQLQJHU VRP OLJJHU WLO JUXQ

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NDONXODWRUHQ 9L jQVNHU Sn GHQQH PnWHQ n V  
NDQ EHQ\WWH GHQQH PRGHOHQ L YnUH EHUHJQL  
JUXQQOHJJHQGH IRUXWVHWQLQJHQH IRU 273 NDO

\*HQHUHOOH IRUXWVHWQLQJHU  
0RGHOHQ IRUXWVHWWHU DW DUEHLGVWDNHUH V  
LQQVNXGGVSHQVMRQ VLGHQ nUV DOGHU RJ WL  
'HW IRUXWVHWWHV YLGHUH DW PDQ MREEHU L  
IUD DUEHLGVOLYHW RJ DW OjQQVXWWDNHUW KROG

,QYHVWHULQJVYDOJ  
'H IOHVWH LQQVNXGGVRUGQLQJHU JLU DUEHLGVW  
VLQH LQQVNXGG 0RGHOHQ IRUXWVHWWHU PRGH  
DNVMHU

\$YNDVWQLQJ  
3URJQRVHQ IRU ODQJVLNWLJ DYNDVWQLQJ Sn GH  
WLO 'HQQH HU VDW ~~WUSrQZDNBYWDD BQ~~ K12W W  
IRUPnO n VWDQGDUGLVHUH GH IRUXWVHWQLQJHQH  
IRU VLQH SURJQRVHU IRU IUHPWLGLJ DYNDVWQLQ  
'LVVH VDWVHQH HU OLN VDWVHQH VRP EHQ\WWHV  
3HQVMRQVIRQG 8WODQG 6DWVHQH HU SUHVHQWH

7DEHOO )RUYHQWHW ODQJVLNWLJ UHDODYNDV  
RJ DNVMHU

		2EOLJDMRQHU	(\$NOGRB
)RUYHQWHW	DYND	VWQLQJ	L

7DEHOO YLVHU ODQJVLNWLJ IRUYHQWHW UHDO  
DYNDVWQLQJVVDWVHQ Sn VRP EHQ\WWHV L P  
DYNDVWQLQJVVDWVHQH L WDEHOHQ RYHQIRU RJ  
DNVMHU RJ UHQWHU 6DWVHQ HU MXVWHUW IRU 1  
LQIODVMRQVIRUYHQWQLQJ Sn

)LQDQV 1RUJH

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7DEHOO ,OOXVWUDVMRQ DY OjQQ YV XWE\WV

8WE\WWH /jQQ

5HVXOWDW IjU OjQQ RJ VNDWW

/jQQVNRVWQDG

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'HW DQWDV DW DUEHLGVNDUULHUHQ VWUHNHNU V  
SHQVMRQVWLOY UHOVHQ 'HQ nUOLJH SHQVMRQVX  
IRUXVHWWHU IXOO RSSWMHQLQJ IUD IRONHWU\J  
RSSWMHQLQJVnUHQH YLO HQ SHUVRQ VRP YHOJHU  
Kj\HUH QHWWRXWEHWDOLQJ VRP NDQ LQYHVWHUH

6RP YL VHU NDQ XWWDN DY XWE\WWH JL OHGHUHQ  
ODYH HOOHU PDQJOHQGH OjQQVXWWDNHW NDQ LF  
SHQVMRQVXWEHWDOLQJHU /DYH HOOHU PDQJOHQ  
UHWLJKHWHQH L IRUELQGHQVH PHG WU\JGHRUG  
HOOHU XIjU 'HUVRP LQQWHNWHQ RJ GHUPHG XW  
Sn DUEHLG XWIjUW DY HQ V\NHPHOGW OHGHU YLO  
OHGHU VRP KDU WDWXW OjQQ RJ RSSWMHQW W  
L VOLNH WLOIHOOHU Y UH EGHU VLNUHW DY WU\

%HUHJQLQJHQH DY SHQVMRQVWDS HU EDVHUW Sn  
YLNWLJ n PHUNH VHJ DW GH SHQVMRQVWDSHQH V  
HNVHPSHOW RYHQIRU RJ L GH IRUHJnHQGH DYV  
GHWWH OjQQVQLYnHW KROGHV WLOQ UPHW NRQV

6RP YL VHU DY DUJXPHQWVMRQH RYHQIRU HU G  
OHGHU EjU YHOJH XWE\WWH HOOHU OjQQ HOOHU  
NRQNOXVMRQ NUHYHU DW PDQ JnU PHU L G\EGHQ  
OLYVVLWXDVMRQ HWF PHQ GHWWH HU XWHQIRU

, GHWWH DYVQLWWHW KDU YL VHWW Sn OjQQVQLY  
EHUHJQLQJHU DY SHQVMRQVWDSHW WLO GH OHGH  
QHVWH GHO DY VWXGLHQ IRUVjNH n ILQQH NMHQQ  
OjQQ RYHU \* 'HWWH YLO YL JMHQQRPIjUH YHG

.MHQQHWHJQ YHG GH VHOVNDSHQH GHU OHGHU  
9L YLO L GH QHVWH DYVQLWWHQH IRUVjNH n XWD  
VYDU Sn RP GHW HU VSHVLHOOH NMHQQHWHJQ YH  
OHGHU WDU XW OjQQ RYHU \*

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.U\VVWDEHOHU

)iU YL JMHQQRPI;UHU UHJUHV MRQVDQDO\VHQ YLO  
GH XDYKHQJLJH YDULDEOHQH IRU n IRUV;NH RJ VL  
YDULDEHOHQ RJ RP GHW HU VSHVLHOOH NMHQQHV  
O;QQ RYHU \* 9L KDU GHOW GH Q R P Q R P O H W X D  
DYNDV V D O J V L Q Q W H N W H U V W i U U H O V H J H Y D U L D  
D O G R Q L L Q W H U Y D O O H U I R U n J M i U H N U \ V V W D E H O

/iQQVRPKHW

, WDEHOO QHGHQIRU VHU YL Sn OHGHUO;QQ P  
/iQQVRPKHWHQ HU GHOW RSS L I;OJHQGH LQWHUY  
PHOORP RJ RJ DYNDVWQLQJ RYHU

7DEHOO /HGHUO;QQ PRW DYNDVWQLQJ IRUGH

	/iQQVRPKHW			7RWDO
	1HJD DYNDVWQLQJ	\$YNDVWQLQ QLQJ	\$YNDVV RYHU	
/HGHUO;QQWDOO XQGHU *\$QGHU				
/HGHUO;QQWDOO RYHU *\$QGHU				
7RWDO \$QWDOO				

6RP YL VHU DY WDEHOO HU GHW HQ NODU WHC  
O;QQ RYHU \* ;NHU PHG QLYnHW Sn O;QQVRPKH  
QHJDWLY DYNDVWQLQJ WDU DY OHGHUQH XW  
VHOVNDS PHG DYNDVWQLQJ PHOORP RJ RJ  
RYHU

6DOJVLQQWHNWHU VW;UUHOVH

, WDEHOO QHGHQIRU VHU YL Sn OHGHUO;QQ P  
EHGULIWHQH 6DOJVLQQWHNWHQH VNDO UHSUHVH  
I;OJHQGH LQWHUYDOOHU VDOJVLQQWHNWHU PHO  
VDOJVLQQWHNWHU PHOORP NU RJ NU  
RJ NU RJ VDOJVLQQWHNWHU RYHU  
7DEHOO /HGHUO;QQ PRW VDOJVLQQWHNWHU I

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	6DOJVLQQWHNWHU			
	PLOO	PLOO	PLOO	PLOO
/HGHUO;QQWDCO XQGHU *\$QGH				
/HGHUO;QQWDCO RYHU *\$QGH				
7RWDO \$QWDCO				

6RP YL VHU DY WDEHOO HU GHW HQ NODU WHG  
 O;QQ RYHU \* ;NHU PHG VHOVNDSHWV VW;UUHO  
 VDOJVLQQWHNWHU PHOORP NU RJ NU  
 7LOVYDUHQGH HU DQGHOHQ L GH VHOVNDSH  
 6DOJVLQQWHNWHU RYHU NU WLO  
 UHJQVNDVORYHQ 6HOY RP YL VHU HQ NODU WHG  
 O;QQ RYHU \* ;NHU HU GHW HWWHU YnU RSSIDV  
 DY OHGHUQH L GLVVH VVXQHUVHOVNDSHQH WDU X

.M;QQ

6RP WDEHOO RYHQIRU YLVHU HU FD DY OH  
 OLNKHW PHG GH ;YULJH YDULDEOHQH ;QVNHU YL  
 PHOORP GHW O;QQVXWWDNHW VRP JM;UHV RJ OH  
 YL Sn GHQ DYKHQH;YULJH YDULDEOHQH OHGHUV

7DEHOO /HGHUO;QQ PRW OHGHUV NM;QQ

\$M;QQ;GHU H @i p  
 .YLQQH 0DQQ

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5HJUHV MRQVPRGHOOHQ

\*MHQQR P NU\VVWDEHOOHQH L GH IRUHJnHQGH DY  
RYHUVLNW RYHU HYHQWXHOOH HJHQVND SHU NMHC  
XW OjQQ RYHU \* 'LVVH HJHQVND SHQH YLO YL )  
HQ ORJLVWLVN UHJUHV MRQVPRGHOO

0XOWLNR OOLQHDULWHW

)jU PDQ JnU L JDQJ PHG HQ UHJUHV MRQVDQDO\VH  
PXOWLNR OOLQHDULWHW PHOORP GH XDYKHQJLJH  
0XOWLNR OOLQHDULWHW RSSVWnU GHUVRP GHW H  
YDULDEHO RJ GH jYULJH XDYKHQJLJH YDULDEOHQ  
VWjUUH VWDQGDUGIHLO L UHJUHV MRQVDQDO\VHQ  
SnYLUNQLQJ Sn GHQ DYKHQJLJH YDULDEHJLDEHHD



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7DEHOO .RUUHODVMRQ PHOORP GH XDYKHQJL

	%HOLJJH	QEGHU	CHQVRPK	HWDU XWE	WDOHVLQQ	WMDQOH	GHU
%HOLJJH	3HHDUVRC &RUUHODWLRQ 6LJ VLGLJ 1						
\$OGHU OH	3HHDUVRC &RUUHODWLRQ 6LJ VLGLJ 1						
/iQQVRPK	3HHDUVRC &RUUHODWLRQ 6LJ VLGLJ 1						
+DU XWE	3HHDUVRC &RUUHODWLRQ 6LJ VLGLJ 1						
6DOJVLQQ	3HHDUVRC &RUUHODWLRQ 6LJ VLGLJ 1						
.MiQQ OH	3HHDUVRC &RUUHODWLRQ 6LJ VLGLJ 1						

.RUUHODVMRQ HU VLJQLILNDQW Sn QLYn VLGLJ  
 .RUUHODVMRQ HU VLJQLILNDQW Sn QLYn VLGLJ

7DEHOO YLVHU KYRUGDQ GH XOLNH XDYKHQJL  
 KYRU PDQJH HQKHWHU VRP HU WHVWHW 9L VHU D





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QHVWH DYVQLWW KYRU YL JMHQQRPNU RJ WHVWH  
SUHVHQWHUW WLGOLJHUH

+ \SRWHVHWHVWLQJ

9L YLO L GHW YLGHUH NRQVHQWUHUH RVV RP KYH  
NRQNOXGHUH KYRU YL LGW YL NDQ EHKROGH HOOHU

'HW HU DOWHUQDWLYK \SRWHVHQH VRP HU SU  
EHW \U IRUNDVWHO V H DY QXOOK \SRWHVHQ 7DEHO  
YDULDEOHQH V VLJQLILNDQV 6LJQLILNDQVQLYnHW  
YL DNVHSHUHU n EHJn IHLO L GH VLWÀ @PLJQL G  
Y W I R L L Q V C E J N W H S W H P L D W J R h J @ W J R W À W P B Q Q W Q Q Q @  
EYUQ NAW PAVGSAADU NCPAWDSTW HAWG@WCHPA P, MW Q N DRU PL, DV

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6DOJVLQQWHNWHU VWjUUHOVH

.RHIILVLHQWHQ WLO GHVQDXDYKFKQUMBYHVMHUGLHWE MWL  
7LOKjUHQQGH RGGVUDWLR EOLU IjOJHOLJ DYUXQGF  
'HWWH YLO VL DW PRGHOHQ SUHGLNHUHU DW VH  
LQQYLUNQLQJ Sn V DQQV\QOLJKHWHQ IRU DW OHG  
9DULDEHOHQ HU VLJQLILNDQW Sn HW QLYn  
K\SRWHVHP IDW V DQQV\QOLJKHWHQ IRU OjQQ RYHU  
VWjUUHOVH

.MjQQ OHGHU

.RHIILVLHQWHQ WLO GHVQDXDYKFKQUMBYHVMHUGLHWE MWL  
RGGVUDWLR HU 'HWWH YLO VL DW V DQQV\QO  
RYHU \* HU JDQJHU Kj\HUH HQQ IRU HQ NYL  
VLJQLILNDQW Sn HW QLYn 'HWWH VDPVYD

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YLGHUH IRUVNQLQJ YHG DW PDQ JMHQQRPI;UHU  
QnU GHW Q\H RSSWMHQLQJVV\VWHPHW HU PHU NM

0DVWHURSSJD

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6WDWLVWLVN 6HjQVDDVWVWVJDSHW PHOORP NY  
PHQQ EH+VQWUHW RDUWS ZZZ VVE QR DUEHLG  
ORQQ DUWLNOHU RJ SXEOLNDVMRQHU ORQQVJ  
EHVWDDU

6WDWLVWLVN 6HjQVDDVWVWVWVJDSHW PHOORP NY  
KWWS ZZZ VVE QR DUEHLG RJ ORQQ VWDWLW

6WDWLVWLVN 6HjQVDDVWVWVWVJDSHW PHOORP NY  
KWWS ZZZ VVE QR DUEHLG RJ ORQQ VWDWLW

6WRUHEUDQG YRUIRU Q\ SHQVWVWVWVWVJDSHW PHOORP NY  
KWWS ZZZ VWRUHEUDQG QR VLWH VWEEDV

6WRUHEUDQ'G YLNWLJVWVWVWVWVWVJDSHW PHOORP NY  
EIGHJUEHJHWHYL S



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9HGOHJJ \$YLVDUWLNNHO

,QQKROG

\$YLVDUWLNNHO L \$IWHQSRVWHQ YHGUjUHQGH SHO







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EHQ\WWHU IRU n LQQKHQWH RSSO\VQLQJHU RP OH  
DQDO\VHQH L YnU VWXGLH

1nU GHW JMHOGHU KYRU LQIRUPDVMRQH L &&\*5  
NRQWDNW PHG ,YDU 2WWR (NNHU VRP HU GDWDE  
DW LQIRUPDVMRQH EO D KHQWHV IUD ([SHULDQ  
(YU\ (WWHU DW ILOHQH HU PRWDDW IUD GH XO  
WHNVWIRUPDW 'HUHWWHU DQRQ\PLVHUHV RJ WLO  
YDVNHV (WWHU GHWWH ODVWHV GH RSS L GDWD  
OHYHUHV XW WLO EUXNHUQH

6366

+jVWHQ KDGGH YL NXUVHW OHWRGHNXUV IRU  
6RP HQ GHO DY GHWWH NXUVHW ILNN YL WLOJDQJ  
6366 9L KDU GHUIRU YDOJW n EUXNH GHWWH SUR  
DQDO\VHU +DQGHOVKj\VNROHQ %, EHQ\WWHU 636  
VWDWLVLNNSURJUDPPHU RJ GHW HU L GHQ IRUE  
GHQQH SURJUDPYDUHQ , GHQQH NXUVEHVNULYHO  
PDUNHGHV L nU RJ DW VHOVNDSHV HU UHSUHV  
OHG GHWWH HU GH HQ DY YHUGHQV PHVW EHQ\WW  
9LGHUH NDQ PDQ OHVH DW 6366 EHQ\WWHV LQQHO  
LQQHQ IRUVNQLQJV RJ XWGDQQHOVHVPLOMjHU F  
LQNOXGHUW EDQNHU RJ ILQDQVVHOVNDSHU 636  
GDWDDQDO\VH VWDWLVLVNDQDO\VH RSSVXPPH  
EHUHJQLQJHU RJ JUDILVNH IUHPVWLOOLQJHU

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7DEHOO .RQWUROO DY UHJLVWUHUW OHGHUO;QQ  
)RUYDOW RJ RP VHOVNDSHQH KDU 273 HOOHU LNN

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.RPPHQW DU WLO WDEHOO  
 7DEHOOHQ YLVHU GH VHOVNDSHQH KYRU YL KDU  
 &&\*5 GDWDEDVHQ PRW UHJLVWUHUW O;QQ L 3URII  
 YL VHOVNDS RJ IDQW DY YLN DY GLVVH DY YL  
 XOLNH DYUXQGLQJVUHJOHU IRU GH WR GDWDEDVH  
 RJ Sn EDNJUXQQ DY GHWWH ;QVNHW YL n NRQWUR  
 YL IDQW IOHUH IHLO , GHQQH NRQWUROOHQ EOH  
 GDWDEDVHQH )HLOHQH VRP YL RSSULQQHOLJ IDQ  
 I;OJHU LNNH RSS DY YLNHQH \WWHUOLJHUH  
 , VLVWH NRORQQH L WDEHOOHQ IUHPNRPPHU GHW  
 LNNH RJ YL VHU DW DY GH NRQWUROOHUWH

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9HGOHJJ 3HQVMRQVEHUHJQLQJHU

,QQKROG

7DEH%UHUHJQLQJ DY SHQVMRQ IRU GH XOLNH LQQV

7DEH)ROU GHOLQJ DY LQQWHNWVLQWHUYDOOHQH Sm

.RPPHQWUDUHU WLO WDEHOOHQH

7DEHOO %HUHUHJQLQJ DY SHQVMRQ IRU GH XOLNH

\$OGH\$QWDOO \$QGHQ

3HQVMRQ  
2SWLPDO SHQVMRQ  
7DSW SHQVMRQ

3HQVMRQ  
2SWLPDO SHQVMRQ  
7DSW SHQVMRQ

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\$OGH\$QWDOO \$QGHO

3HQVMRQ  
2SWLPDO SHQVMRQ  
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7DSW SHQVMRQ

3HQVMRQ  
2SWLPDO SHQVMRQ  
7DSW SHQVMRQ

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7DEH)ROJGHOLQJ DY LQQWHNVLQWHUYDOOHQH Sm

XQGHU

\* RYHU \*  
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9HGOHJJ ± 3HQVMRQVEHUHJQLQJHU 273  
,QQKROG

7DEHOO UHJQLQJ DY I;UVWH nUV SHQVMRQVXWEHW  
.RPPHQW DU WLO WDEHOHQ

7DEHOO %HUHJQLQJ DY I;UVWH nUV SHQVMRQVX

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\$OGH U% HUHJQLQJ DY I;UVWH nUV SHQVMRQVX



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\$OGH U \$QWDOO \$QGH O

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6LGH

\$OGH U \$QWDOO \$QGHO	cUVLQQWHNW					
3HQVMRQ 7DSW SHQVMRQ SHU OjQQVLQWHUYDOO						
3HQVMRQ 7DSW SHQVMRQ SHU OjQQVLQWHUYDOO						
3HQVMRQ 7DSW SHQVMRQ SHU OjQQVLQWHUYDOO						
3HQVMRQ 7DSW SHQVMRQ SHU OjQQVLQWHUYDOO						
3HQVMRQ 7DSW SHQVMRQ SHU OjQQVLQWHUYDOO						
3HQVMRQ 7DSW SHQVMRQ SHU OjQQVLQWHUYDOO						
3HQVMRQ 7DSW SHQVMRQ SHU OjQQVLQWHUYDOO						
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\$OGH U \$QWDOO \$QGHO

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OjQQVLQWHUYDOO

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6LGH