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How to digitally enhance bioeconomy
collaboration:multidisciplinary research teamideation for
technology innovation

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2020-11

Ryymin , E , Lamberg , L & Pakarinen , A 2020 , ' How to digitally enhance bioeconomy
collaboration:multidisciplinary research teamideation for technology innovation ' ,
Technology Innovation Management Review , vol. 10 , no. 11 , pp. 31-39 . <https://doi.org/10.22215/TIMREVIEW/1401>

<http://hdl.handle.net/10138/355717>

<https://doi.org/10.22215/TIMREVIEW/1401>

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Kr z w Glj lvdō Hqkdqf h Elr hf r qr p | Fr oeder udvr q=P xwglvf lsdqduj Uvhduf k Whdp Lghdvr q ir uVhf kqr σ j | Lqqr ydvr q Hwl U| | p lq/ Odxud Oap ehj) Dqqx nnd Sdnduqhq

Ui f gwsf jt cvjrapo ü f gpx pgofx jefbt/
SdxoP h| hu

Lq vlv sdsu z h h{dp lqh vkh sr vñqv dori glj lvdosævr up v ir up dgdj lqj p xwglvf lsdqduj fr oeder udvr q dgg sduwf xædu vkh lghdvr q surfhwv ri p xwglvf lsdqduj uhvduf k dgg ghyhæ sp hqwlq vkh fdv ri vñfkqr σ j | Ovxssr uñg yhuwf do idup lqj 1 Vkh duwf dh gudz v r q uhvduf k gdvd iurp vhp lOvwx f w ÷hg lqvñyhlz v dgg d fr oeder udvlyh zr unvkr s vkwz dv fr qgx f vñg z lvk uhvduf khw uhsuhvqwj elr σ j lf dō glj lvdō dgg vñfkqr σ j lf dogrp dlqv 1 Vkh uhvduf k ri vlv uhvduf k lqglf dñ vkw dw glj lvdō sævr up v p dl riihu lp sdf vix d surfhw 0 df fhdudvñqj vxssr uwgxudqj vkh nlf n 0 ii skdv ri p xwglvf lsdqduj vñfkqr σ j lf dolqqr ydvr qv 1 D glj lvdosævr up f dq vxssr uwlghdvr q dgg vkh sur udvudvr q ri lghdv dgg f dq eh hvshf l dō ixlwixoz khq sdlhg z lvk idf h w idf h glvf xvvr q dgg qr qOglj lvdolqvñudf vñr q 1

2753(8' 7-32

Dv vkh Hduk v vñp shudv xuhv ulv/ elrglyhuwlv lv soxp p hvñqj / vr loqxvñhqw duh ehlqj σ w dgg vkh zr ugg sr sxævr q nhsv j ur z lqj 1 Vkh qhg ir uixqgdv hqv dō fkdqj hv lq vkh dj u 0 rrg vñf w uqr z vñhp vxqghl dē dñ 1 Vñfkqr σ j lf dodgydqf hp hqwkdv r i vñq ehq w xvñg dv d vr ævr q r q vkh ur dg w vxwvñlqdel d vñ / dgg lq uhfhqwg hfdghv vkh frqyhudvñr q kvd ehq hquf khg el iudp hz r unv vxfk dv vkh vñf r Oñf kalf do vudqvñvr qv dssur dfk ÷ Jhho / 5344/ 534<, 1 D fr ug lqj w vlv dssur dfk / vxwvñlqdel d vñ vudqvñvr qv uñd r q vñhlqj d v l vñp lf rxv r n w fkdqj h = vñfkqr σ j lf do dgydqf hp hqwlv nh / exwvr dvr lv uhvwx f vñudqj vñf l do p hdqlqj v / fr qvxp hu ehkdylr u / s r dñ l h / exvlqhv p r ghv / dgg vr r q ÷ Jhho / 534<, 1 Vklv uht xlvh vkh lqyr gñp hqwr i p xwv s dñ df w u lq gliihuhqwilhg v ri di h TM vñf l hqwlwv lq ydvr xv glvf lsdqhv / s r dñ | p dñ hu / hgx f dñ w / dgg lqgxvñl dñ h 1

Vkh lqv r gxf vñr q dgg ghyhæ sp hqwr i qhz vñfkqr σ j | f uñd vñr s sr uwx q l vñv dgg fkdæñqj hv ir uuhvduf k p xfk eh | r qg vkh r eylr xvñhg v ri hqj lqhñd qj 1 Lq vkh fdv ri vkh dj u 0 rrg vñf w u lqqr ydvr qv vxfk dv yhuwf do idup lqj kdyh ir vñhg uhvduf k dgg ghyhæ sp hqwkdw eulqj v w j hv kh u uhvduf khw dñ r w glvf lsdqduj

er xqgdñ hv 1 Z khq nqr z dñg h der xw vñf r Oñf r σ j lf do suredñp v lv lqfr p s dñ vñ / p xwglvf lsdqduj ÷ ru vudqvglvf lsdqduj , uhvduf k f dq eh xvñg w dgguhv suredñp v dgg vñhn vr ævr qv vkw dw kr ggp lp s ru v d qv lp sdf dñvr qv ir u vkr vñ diihf vñg el vkh p ÷ Qr uulv hwd d / 5349 / uñhu lqj w Sr ko) Kluf k Kdgr uq / 533 : , 1 - P xwglvf lsdqduj - kvd vkv v ehfr p h qhf hwd d w xqghu v dgg vkh fr p s dñ { qdv xuh ri hfr σ j lf do vxwvñlqdel d vñ suredñp v / w h { shulhqf h ydvr xv fr qv u l exvñr qv iurp gliihuhqwg l v lsdqduj edf nj ur xqgv / dgg w riihud p r u h fr p s dñ vñ fr u h v s r qglqj vñv r i w r æ ÷ ru h { dp s dñ / vñf kalf dō ehkdylr u d lqglylgx d d dgg r u j dqlv dñr qd q ir u dgguhv lqj dgg suhyhqvñqj vxwvñlqdel d vñ fkdæñqj hv lq uñd dñ h 1

Kr z hyhu / sudf vñf lqj p xwglvf lsdqduj f dq eh yhu fkdæñqj lqj 1 Uhvduf khw iurp gliihuhqwg edf nj ur xqgv p xvwdñduq w xqghu v dgg dgg dssuhf l dñ h dñ k r v kh u v shu vshf vñy vñ ÷ vñf kr r w X l vñ uñd p s) Y dñ / 533 : , 1 S u h y l r x v uhvduf k kvd lghqwilhg d σ qj dñv ri fkdæñqj hv dñv r f l d vñg z lvk p xwglvf lsdqduj uhvduf k ÷ Udp dñ hu / 533 > Vñf kr r w X l vñ uñd p s) Y dñ / 533 : > S r ko) Kluf k Kdgr uq / 533 ; , 1 D q hvshf l d d fkdæñqj lqj sur edñp dñv hv lq iudp lqj vkh uhvduf k dgg uhvduf k sur edñp v ÷ O d q j hv d d / 5345 , 1

Kr z w Glj lwd} Hqkdqf h Elr hfr qrp | Fr oeder udvr q=P xovglvf lsdqduj Uvhduf k Whdp Lghdvr q ir uWhf kqr σ j | Lqqr ydvr q Fttj Szn jo-Mvsv Mn cf sh' Boovl l b Ql bsjof o

Iru vklv vxg|/ rxu lqvuuhw z dv w lqyhwlj dvn p xovglvf lsdqduj fr oeder udvr q ri d uhvduf k vndp vdf ndqj vxwllqdelduj lvxhv lq vkh dj uQrrg vhf w ul Z lvk vklv dlp lq p lqg/vkhrerthf vlyh z dv w lqyhwlj dvn d glj lwd} Ovxssr uing lghdvr q z runvkr s dv d p hvkr g iru vkh ghilqlvr q ri uhvduf k lghdv lq d p xovglvf lsdqduj vndp 1 Vkh fr qv{wri vkh vxg| z dv d ghyhσ sp hqw sur rthf wri vp duwdqg vxwllqdeh elr hfr qrp | ghdyhng lq d klj khuhgxf dvr q lqvwvvr q 1 Vkh sur rthf w vudvuj lf jr dō f dōng iru uhvsr qglqj w vkh qhng iru vxwllqdeh irrg sur gxfvr q/ z klh dgguhvlqj vkh p hj dwhqgv ri glj lwd} dvr q d qg fōp dvn fkdqj h 1 Vkh ghyhσ sp hqw sur rthf w lq d p xovglvf lsdqduj vxwllqdeh lqqr ydvr qv vkr xj k gvdō gulyhq nqr z dngj h f uhdvr q lq vkh elr hfr qrp | 1 Vkh klj khu hgxf dvr q lqvwvvr q uhvduf khw d qg qhvz run ri elr hfr qrp | fr p sdqlhv z runhg lq fōv h v d qv glvf lsdqduj fr o shudvr q gxuqj vkh sur rthf w

Rxuvshf lilf ir f xv ri lqvuuhwz dvr q d p xovglvf lsdqduj vndp ri uhvduf khw/ z klfk z dv uhvduf klqj d qg ghyhσ slqj -vp duwyhuf doidup lqj -Yhuf doidup lqj lv d qryhosudf vhf h vkdv h{shf vng w vxssd irrg w flwhv vxwllqdeh ru z lvk ydōx h dggghg elrp dv iru vkh lqgxvwl +DōFkdōel/ 5348,1 Vkh klj khu hgxf dvr q lqvwvvr q ufh hqvō w d vng d vxwllqdeh d v r u h qvng uhvduf k sur rthf w r q y h u f d o i d u p l q j / z k l f k l q f α g h g l p s d h p h q w l q j g d v l d q d d v l v l q r s w p l v l q j e l r p d v s u r g x f v r q l q f r q w r a n g f r q g l v r q v d w d f r q v l l q h u i d u p 1 U h v d u f k l q d f r q w r a n g f x o v y d v r q h q y l u r q p h q w h q d e d n g y d u r x v s r v l e d v h v i r u v k h s d u f l s d q w 1 V k l v u d a j h g i u r p i l q g l a j v r α v r q v w i l j k w d j d l q v k x a j h u l q d f k d a j l a j f d p d v n / w r s w p l v l q j s a d q w j r z l a j f r q g l v r q v l q r u g h u w k h a s d l g l q v d q v l v r q i u r p v k h f x u h q w i r w l o h f r q r p | w d e l r e d v h g h f r q r p | / e l s u r g x f l a j v s h f l i l f e l r e d v h g f r p s r x q g v i r u i x u k h u s u r g x f w 1

Vkh vlj qlilf d q w j r d o r i v k h v p d u w y h u f d o i d u p l a j s u r r t h f w l v w f u h d v n g l j l w d } h g p h d v x u h p h q w / l a f α g l a j i r u L r W +L q v u h q h w r i V k l a j v, O e d v h g g d v l f r a n h v r q / d a d d v l v / d a g l q v n u s u h v d v r q l q d a d d v l a j / p r q l w u l a j / d a g r s w p l v l a j v k h y h u f d o i d u p l a j s u r g x f v r q f k d l q v 1 V k h s u r r t h f w e u l a j v w j h v k h u p x o v s d h u h v d u f k l q v u h w w d a g f r p s h v n q f h v l q v k h d i h v f l h a f h v / v n f k a r σ j | / g l j l w d v h y l f h v / d a g v k h i l h a g r i h g x f d v r q w l q y h w l j d v n v k h u h v d u f k d u h d r i v x w l l q d e h d a g v p d u w e l r h f r q r p | 1

Vkh iluwskdvh ri vkh vp duwyhuf doidup lqj sur rthf wz dv vkh exlq lqj ri d fr oeder udvr q uhvduf k vndp d qg vhw lqj ri dj uhg Ovxsr q uhvduf k lghdv d qg lqvuuhw 1 Hvhq v d o l q v k l v s k d v h l v v k d w d u h d o z r u a g f k d a n g j h l v v d q v a d v n g

lqwr d sur p lqhquuhvduf k lghd/ d er xqgdul r erthf w vkdw lver vk uhvduf k dedh d qg dō z vir uvkh u h o q v n j u d v r q r i l q v l j k w i u r p g l i i h u h q w v f l h q w i l f e r g l h v r i n q r z d n g j h +O d a j h w d d / 5345,1

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Vyhudo dxvkr w kdyh uhfrjqlvhg fkdōngj hv lq nqr z dngj h vkduqj d qg mlqwhqghdyr xw z khq z runlqj r q d fr p s d h { r e r t h f w r i u h v d u f k d f v y l w l q p x o v g l v f l s d q d u j f r o e d e r u d v r q +U d p d g l h u / 5337 > V f k r r w X l v n u d p s) Y d n / 533: > S r k o) K l w f k K d g r u a / 533; > O d a j h w d d / 5345,1

Hgz dugv +5343/ 5345, ghyhσ shg d fr p shōqj vkr uhv do fr qf hsw f dōng -uhōvr qdo h{shuwh-ir u d q d d v l a j d a g f r q f h s w d d v l a j f r o e d e r u d v r q e h v z h h q h { s h u w 1 E | u h a d v r q d o h { s h u w h H g z d u g v p h d q v d i r u p r i h { s h u w h v k d w d x j p h q w r q h v v s h f l d d v w h { s h u w h d a g p d n h v u h v s r q v l y h f r o e d e r u d v r q s r w l e d h 1 U h a d v r q d o h { s h u w h l a y r o y h v v k h d e l d v l w v a n h l q w d f f r x q w v k h w d a g s r l q w r i r v k h u f r o e d e r u d v r w / u h f r j q l v h z k d w p d w h w w v k h p z k h q z r u n l a j r q d q s u r r t h f w p d n h y l v e d h w v k h p z k d w p d w h w i r u | r x / m l q w l h { s d a g v k h l q v n u s u h v d v r q r i v k h v d n / d a g f d d e u d v n u h v s r q v h v v r v k d w h { s h u w f d q z r u n r q l w w j h v k h u +H g z d u g v / 534: , 1 U h a d v r q d o h { s h u w h h q d e d h j u h d v n u h a d v r q d o d j h a f | / z k h u l q s h r s d h d u h d e d h w z r u n w j h v k h u r q f r p s d h { d f v y l w h w +H g z d u g v 5343/ 5345/ 534: , 1 U h a d v r q d o d j h a f | l a y r o y h v h { s d a g l a j x s r q v l a j x a d u l q v n u s u h v d v r q v r i d s k h a r p h a r q e l e u l a j l a j w e h d v k h g l i i h u h q w h { s h u w h r u f r q f h s w d o u h v x u f h v r i i h u h g e l z r u n f r o e d e r u d v r w 1 V k l v h { s d a g l a j p h d q v v k d w p r u h u h d y d a w d v s h f w r i s k h a r p h a r q f d a e h u h f r j q l v h g d a g z r u n h g r q +H g z d u g v / 534: , 1

I r a j +5336, l a w r g x f h g d p r g h o r i n q r z d n g j h f u h d v r q z l v k l q p x o v g l v f l s d q d u j s u r r t h f w v n d p v v k d w s a d f h v s u l p d u l h p s k d v l v r q s u r f h v h v / u d v k h u v k d q r x v r p h v 1 l a v k h p r g h d i l y h s u r f h v h v r i n q r z d n g j h f u h d v r q d u h l g h q w i l h g d a g l q v n u z l a h g = 4, e r x a g d u l O f u r v l a j / 5, n q r z d n g j h o v k d u l a j / 6, n q r z d n g j h j h a h u d v r q / 7, n q r z d n g j h l a v n j u d v r q / d a g 8, f r a n h v l y h s u r r t h f w d n d u l a j 1 E h a z z h h { s d a g r q h d f k r i v k h v h s u r f h v h v l q v k h p r g h d

I l u w w f u r v l a j e r x a g d u l h v v x f f h v i x a j u h t x l u h v s h u r q d o f r q y h u d v r q v d p r a j v n d p p h p e h w 1 Y l v x d d v h g r e r t h f w r i d f v y l w l / v x f k d v v k d u h g g u d z l a j v / f d q k h a s z l v k v n d p l q v u d f v r q 1 V h f r a g / n q r z d n g j h o v k d u l a j f u h d v n e h q h i l w z k h q s u r r t h f w v n d p p h p e h w

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r q glyhū hqweudlvvr up lqj vōv v vkdō vkr v h lqvudf vqj
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lq vōp v ri xq p ehur i lghdv j hqhudvng dqq hqkdqf hv vkh
fr j qlvlyh shuwshf vlyh ri j ur xs f uhdvlyv1 Dōr / Mqv hq
dqq fr o dxvkr w +534;, vwxglhg er vk idf hōv dōf h
-sk| vlf dō dqq glj lvdō -r qdōq, fr oeder udvlyh lghdvr q/
dqq vkh| dū xh vkdw fr oeder udvlyh lghdvr q fdq
vfffhvixōj eh vxssruwng glj lvdōj 1 VKh qh{wvhs lq
lp sur ylqj vkh vnf kqr σ j l f do vhwxs iru fr oeder udvlyh
lghdvr q gr hv qrw krz hyh/ uht xlv dō hlvkhōru
v f hq dūr 1 lqvōdō/ lvvkr xōg eudqj vkh ehvri vkh v r
z r uōv/ sk| vlf dō dqq glj lvdō w j hvk hu1

Khō lqj w z r un w z dugv vlv j r dō z h vhwv dō r erhf vlyh
iru vkh vwxgl w lqyhwlv dōh v r dōhv ri lqt xlv = iluvōj /
vkh h{shf vōvr qv ri uhvduf khw/ dqq vhf r qdō / vkh
uhvōw ri glj lvdōj fr oeder udvlyh lghdvr q1 Z h vkv sr vhg
vkh ir o z lqj uhvduf k t xhwvr qv = Z kdw z hūh vkh
h{shf vōvr qv iur p vkh p xwglvf lsdqduj uhvduf khw ri
vp duw dqq vxvōlq dōh elr hf r qrp | / uhj duglqj vkhlu
uhf l sur f do fr oeder udvr q B Dqq z kdw z hūh vkhlu
h{shf vōvr qv iru vkh vp duw yhwf do idup lqj sur rhf v B
Dgglv r qdōj / vkh vwxgl dvhwvhw krz d glj lvdō sōvr up
z dv lp sōp hqvng zlvk dō dlp w hqkdqf h vkh
fr oeder udvlyh lghdvr q sur fhv ri uhvduf k lghdv lq vkh
vp duw yhwf do idup lqj sur rhf v l Khqf h/ z h dvhng = z kdw
z hūh vkh uhvōw ri vkh glj lvdōj hqkdqf hg fr oeder udvlyh
lghdvr q/ dqq z kdwydōh glg vkh glj lvdō sōvr up sur ylg
w vkh lghdvr q sur fhv B lq dqvz hūqj vkhvh t xhwvr qv/
z h uhidfvng r q vkh lp sdf w ri vkh glj lvdō sōvr up / el
dvhwlvqj ihgedf n iur p vkh uhvduf khw dv z hō dv
fr p sdōqj vkh uhvōw ri lghdvr q w vkh uhvduf khw
lqlv dōh{shf vōvr qv 1

Kr z w Glj lvdō Hqkdqf h Elr hfr qrp | Fr oader udwr q=P xwglv f lsdqduj Uvhduf k Whdp Lghdwr q ir uWhf kqr σ j | Lqqr ydwr q Fttj Szn jo-Mvsv Mn cfsh' Boovl l b Ql bsjof o

%% 300' 7-32 %2() 7, 3(308+-' %0 4453%,

Vkh gdvd lq vlv wvg| frp hv iurp hdyhq +44,/ r qh0 q0 r qh vhp l0wxf vxuhg lqvnylhz v zlvk uhvduf khw lqyrōyhg lq d vp duw dgg vxwvllqdedh elr hfr qrp | ghyhσ sp hqw sur rhf w dgg d fr oader udvlyh lghdwr q zr unvkr s zlvk vl{ +9, uhvduf khw irfxvlqj r q vp duw yhuwf do idup lqj 1 llyh ri vkh vl{ sdw f lsdqw ri vkh yhuwf do idup lqj zr unvkr s dar ehσ qj hg w vkh lqvnylhz hg hdyhq uhvduf khw/ z klōh r qh ri vkh vl{ glg qrv Vkh lqvnylhz hhw eur dgd uhsuhvqvhg elr σ j l f do vf lhqf h/ glj lvdō dgg whf kqr σ j l f dogr p dlqv/ z khuhd vkh edf nj ur xqgv ri vkh zr unvkr s sdw f lsdqw udqj hg df ur v gliihuhqwxe Qglv f lsdqhv ri vkh dih vf lhqf hv +ir uh{ dp sd/ elr sur fhw dgg dxw p dvr q hqj lqhhdqj / kr w f xoxuh/ hqylur qp hqvōohqj lqhhdqj / f khp lvvj , 1

Vkh nh| vkh hv fryhuhg lq vkh lqvnylhz sur fhw z huh vkh lqvnylhz hhw h{shf vdwv qv uhvduf w p xwglv f lsdqduj fr oader udwr q ehvz hhq uhvduf khw iurp gliihuhqwgr p dlqv/ dσ qj zlvk vkhlu h{shf vdwv qv/ hvshf lvdō iru vkh qhz d adxqf khg vp duw elr hfr qrp | sur rhf w lq vkh fr oader udvlyh lghdwr q zr unvkr s/ sdw f lsdqw h{σ uhg dgg glv xwvhg vkhlu uhvduf k lghdv fr qf huqlqj vp duwyhuwf do idup lqj 1 Vkh lqvnylhz v dgg vkh zr unvkr s z huh uhf r ughg/ w dqv f uehg/ dgg dqqd vhg1 Dgg lwr qdō / vkh df vlylvhv ri zr unvkr s p hp ehw lq vkh glj lvdō sōvwr up z huh duf klyhg lq vkh sōvwr up v gdvdedvh

dgg dqqd vhg 1 Vkh wvg| xvhg t xddv vlyh dqqd vlv w j dlq lqv lkw lqw vkh h{shf vdwv qv ri sur rhf w sdw q huw w z dugv p xwglv f lsdqduj fr oader udwr q 1 Vkh fr oader udvlyh fkdv f vhu ri vkh zr unvkr s ri ihuhg dqr vkhu dgydqvōj h iru dqqd vlqj j ur xs glv xwvr q/ nqr z dgg h vkduqj / dgg xvlqj d glj lvdō sōvwr up lq uhvduf k lghd iudp lqj 1 Vkh t xddv vlyh gdvd dqqd vlv lqf αghg vhdv vqj uhdydqw vhw iru ixu vkh dqqd vlv uhvduf w vkh vkh r uhv do idup hz r un dgg suhyr xv uhvduf k 1 Vshf l l f dvhv qwr q z dv sdg w vr of dōhg -uhshd vqj lghd- +Dx huedf k) Vqyhu vhlq/ 5336,1 lq vkh dōvw skdv/ fr khuhqwf dvhj r uhv z huh j ur xshg lqw p ruh devvdf w vkh p hv dgg fr qf hswr 1

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Sftf bsdī fs Fyqf dūj pot
R xu dqqd vlv ri lqvnylhz gdvd uhyddhg vhyhudo h{shf vdwv qv iru p xwglv f lsdqduj fr oader udwr q dgg vp duwyhuwf do idup lqj 1 Vkh vkh hv lghqvilhg lq vkh lqvnylhz v duh vxp p dlvhg lq v dēh 41

Vkh lqvnylhz hhw h{shf vng p xwglv f lsdqduj fr oader udwr q w j hqudvh qhz vr αvr qv iru z lfnhg sur edhp v lqyr q lqj vxwvllqdedh/ hvshf lvdō lq f duer q elqglqj w z dugv suhyhqvōj fōp dvh fkdqj h1 lq vkh fr qvhw ri vp duw yhuwf do idup lqj / vkh lqvnylhz hhw suhglvng qhz vr αvr qv iru fōp dvh ūuhqgd irrg

" %&0 H{shf vdwv qv ri lqvnylhz hhw ir up xwglv f lsdqduj fr oader udwr q dgg vp duwyhuwf do idup lqj

Kr z w Glj lwdō Hqkdqf h Elr hfr qrp | Fr oader udwr q=P xwglvf lsdqduj Uvhduf k Whdp Lghdwr q ir uWhf kqr σ j | Lqqr ydwr q Fttj Szzn jo-Mvsv Mn cf sh' Boovl l b Ql bsjof o

sur gxf wr q vkdw ilj kw dj dlqvw kxqj hu' dgg iru vkh hqhj | Ovdyy | / fr qwr ahg fxwlydwr q ri sōdqw1 Rqh lqvnylhz hh duj xhg vkdw vp duw yhuwf do idup lqj fr xōg j lyh dqvz huw w idp lqhv lq Diuf d e | sudf wf doir r g sōdqw ghyhō sp hqw z klō r vkhw dōr fr qvlghung vkh lp sr uwdqf h ri p hglf do sōdqw/ r uj dqlf fr vp hwf v/ dgg fr σ xw ir uvx wdlqdedh exvlqhwvhv1

Txr vñ 4=

%\wf sj dbrōpsn joh^jt rjōl fe up vscojbtbjpo boe up ū f gōduū buū sf jt rftt rboe bwbjrbcrf gōpsōpsn joh boe-up i px x f dōo qspevf gōpe rpdbrō dptf cz up ū f foe vtf/Ui buf fofshz fggdjfou—

Dp r wllq dōf dvhv/ vkh lqvnylhz hhv uhsr uwhg vkdwvk h | ir uhvh qhz fr pshvqf hv ehqj ghyhō shg vkur xjk p xwglvf lsdqduj fr oader udwr q/ hvshf lōdō lq gdvōgulyhq p hdvxhp hqwdqg vkh qryhoxvhv ri vp duwv hfr qrp | lq vxwdlqdedh elr hfr qrp | 1 Dō qj zlvk fr qf uhv ghyhō sp hqw sur rth w/ p xwglvf lsdqduj fr oader udwr q z dv fr qvlghung w sur ylgh vij qllf dqwōduqlaj sur fhwv ir uvk hvdudf khw iur p gliihuhqwr p dlqv1

Vkh vp duw yhuwf do idup lqj sur rth w z dv qryho w dō sduwf lsdqwr1 Vr p h lqvnylhz hhv ehdyhg vkdw vkh uhvduf k vñdp zrxōg qhng w hwōdōvk lw dōduqlaj sur fhw iur p vkh yhu' edlvf v1Vkh | dōr p hqwr qhg vkdwlv lvlp sr uwdqwr lqyr g h q r wr qd vkh uhvduf khw/ exwdōr vkh klj khuhgxf dwr q lqvnylhz wr vxghqw lq vlv dōduqlaj sur fhwv1

Txr vñ 5=

%qf bl joh pgwf sj dbrōpsn joh-x i jōi jt pof pgu f tvē. qspk dū lpgū f tn bsuboe tvubjōbcrf cjp f dōpn z ef wf rpn fouqspk dū-jujt tpn fū joh upbrō ofx up vt/X f kvtsuf djwfe ū f dōubjōfstz tūn evsjōh ū f tvn n fs/Ui fsf (t opū joh ū fsf zf x f bsf pōrō kvtu tubsjōh ū f gstūōpsn johfyqf sjn fout/%

Txr vñ 6=

%Qpsjotubodf -Jx bt kvtujspevdjoh pvs s f t b s d i voju up pvstwe f out po e j g f s o u d n q v t t r o t u t q s j o h - boe po f w s z d o n q v t -J b t l f e t w e f o u t x i b u x f d p v r e h s p x j o ū f w f s j d b r o p s n j o h g f j h i u d p o b j o f s —

Dō lqvnylhz hhv vxjjhwng vkdw p xwglvf lsdqduj fr oader udwr q lq vp duw dgg vxwdlqdedh elr hfr qrp | wuhqj vk hqv vkh wvduvjlf ghyhō sp hqw ri vflhqwlf

uhvduf k dgg vkh uhvduf k surildn ri vkh lqvnylhz wr q1 Vkh huz huz dōr fr p p hqw der xwqf uhdv lqj vkh dp r xqw ri vflhqwlf sxdōf dwr qv/ ehfr plqj dō dwdvfyh uhvduf k sduw h u lq vp duwdqg vxwdlqdedh elr hfr qrp | qdwr qdō dgg lqvnylhz qdō / dgg ilqglaj qhz uhvduf k ixqglaj vr xuf hvir uvk h f x u h q w w s l f v 1

Txr vñ 7=

%f x j m r p t j u p o p v s f r n f t j o b o f x x b z - u p b o f x q p t j u p o - x i j d i j t - j o s f h b s e p g d p n q f u o d f t b o e s f t f b s d i d s f e j u t - i j h i f s - c f u f s T p - x f x j m r s f b u f b o f x l j o e p g s f t f b s d i q s p g r h \ j o t n b s u b o e t v t u b j o b c r f c j p f d o p n z \ U i j t x j m r e f ū f r f b e j o h f e h f j o p v s s f t f b s d i - \ g s ^ ū f o f y u u i s f f z f b s t / —

Fr qvlghulaj vp duw yhuwf do idup lqj / vkh lqvnylhz hhv zlvkhg w ghyhō s eudqg qhz gdvōj d v k h u l a j p h v k r g v ir u r s v p l v l a j v k h j u r z l a j f r q g l w r q v r i s a d q w / d a g w e h f r p h d u h f r j q l v h g u h v d u f k s d u w h u l q g d v o g u l y h q y h u w f d o i d u p l a j 1 K r z h y h u ' v k h u h v d u f k l g h d v u h a d v n g w y h u w f d o i d u p l a j z h u h l q v k l v s k d v h v k o s u h d p l a d u j / d v z h o d v t x l v h l a f r k h u h q w d a g i u d j p h q v e l j 1

Vr p h lqvnylhz hhv duj xhg vkdwlvv yhu' lp sr uwdqwr j hw sduwghung zlvk elr hfr qrp | fr p sdqlhv dgg exvlqhwvhv/ dgg w ghyhō s qhz vrōvr qv iru vkhlu sudf wf do sur edp v/ dv z hō dv qhz exvlqhw r s s r u x q l w h v l q u h j r q d o p d u n h w 1 V k l v y l h z z d v h f k r h g e l r v k h u l q v n y l h z h h v z k r h p s k d v l v h g v k h s r v l e l d v h v r i y h u w f d o i d u p l a j s u r r t h w h v s h l d a j w j h q h u d v n s u d f w f d o v r o v r q v i r u u h j l r q d o f r p s d q l h v l q q h h g r i s a d q w s u r g x f w r q 1 R q h l q v n y l h z h h d o r v x j j h w n g g y h o s l a j d q d s s d f d w r q i r u e l r h f r q r p | f r p s d q l h v w x v h 1

Txr vñ 8=

%dōn qboz sf djwft ef wf rpn fouubntvqqpsugpn vt \gōs^x i jōi ū f b j n d o c f b q j r p u q s p k d u \ p s ^ b o j o o p w b j w f n f u p e / J u d o c f b q s p u z q f - b q s p d t t - b o p q f s b j o h n p e f m j u d o c f b t f s w j d f - x i b u f w f s j u j t / U i j t j t x i b u b d o n q b o z x j m r h f u b o e x f x j m r h f u b s f t f b s d i b e w b o u b h f / —

Sftvrt pgEjhjbrō Foi bodfe Jefbjpo Vkh vl{ +θ, p xwglvf lsdqduj uhvduf khw iur p vkh vp duw yhuwf do idup lqj sur rth w sduwf lsdvng lq d fr oader udvlyh lghdwr q zr unvkr s vkdw dlp hg w k h a s i u d p h d a g s u r u v w h v k h l u u h v d u f k l g h d v 1 V k h z r u n v k r s z d v g l y l g h g l q v k u h s k d v h v = 4, i d f h o w Q d f h j u r x s g l v f x w l r q d a g l g h d w r q r i u h v d u f k l q v n u h w w / 5, l a g l y l g x d o l p s d n p h q w d w r q r i d g l j l w d o s a d w r u p l q s u r u v l q j

Krz w Glj lwdō Hqkdqf h Elr hf r qrp | Fr oader udwr q=P xwglvf lsdqduj Uvhduf k Whdp Lghdwr q ir uWhf kqr σ j | Lqqr ydwr q Fttj Szn jo-Mvsv Mn cf sh' Boovl l b Ql bsjof o

uhvduf k lghdv/ dqq 6, frqf αglqj glvfxwlrq ri vkh sur ulvvhg lghdv dqq vkhlu sudf wf do lp sōp hqvdwr q1 Rqh ri vkh vl{ sduwf lsdqw frxōg xqir uwxqdvhd qrw sduwf lsdvhlq skdvh5 dqq 61

Vkh glj lwdō sōdwr up xvhg w lp sōp hqvwkh z r unvkr s z dv lqqr gxho ðq'g1/ z klfk z dv ghvj qhg w vxssr uw vlqf kur qrxv jurxs ghflvrq p dnlqj 1 Lqqr gxho z dv fkrvhq ehfxvhr i lw sur p lvtqj t xddvhwlvq vshhglqj xs vkh fkdōhvj lqj dqq glyhvj hqwsurf hvhvr i fr oader udvlyh ghflvrq p dnlqj 1 D sūdp lqduj eudlqwr up lqj vhwlrq ir u vkh uhvduf khw kdg ehq r uj dqlvhg hduhu/ ehir uh vkh uhvduf khw ãvhu kdg vkh r sssr uwxqlv w r uj dqlvh dqq udqn vkh 53 lghdv vkh l kdg fr p hxs z lvk lq vkh sur u vhwlrq1 Lqqr gxho z dv vkvx xvhg lq vklv z r unvkr s vhwlvj w dvlvwlq fr qvxlqj vkh hduhu z r un/ z klfk kdg sur gxf hg dexqgdqwlghdv/ exwãf nhg sur ulvvdwr q uhj duglqj z klfk lghdv r xj kww eh p r yhg ir uz dug1

Vkh Lqqr gxhosōdwr up xvhv dq dssdf dvr q vkdwhqdedv d surfhw ri fr ãhf vqj dqq yr vqj r q ãdj h ru vp dō jurxs lghdv r dōq1 Vkh sduwf lsdqwlv lqylvng w mlq d glj lwdō duhd/ z khuh vkh l f dq vhh z khvku d qhz srw dqvz huw d sduwf xōdu t xhwlrq vkh vhwlrq idf lōvdv ur kdyh f uhdvng ehir uh/ r uf dq yr vhr q h{lvvqj dqvz huw1 Dō dqvz huw z lōhyhqw dō hqg xs r q vkh duhdv udnlqj dōv1 Krz hyhu/ r qd dqvz huw vkdwkdyh dsshdvhg lq vpujoh n pef vl{ vrp hv ru p ruh z lōeh udqnhg1 Dqvz huw vkdw kdyh ehq vkrz q lq dōn qbsjtpo n pef dhw vkdq vl{ vrp hv z lōeh glvsōl hg ehōz vkh udnlqj dōvlq d udqgrp r ughu1 Dv d uhvãw vkh sduwf lsdqw jhw d sur ulv} hg dōvri dqvz huw ðlqqr gxho q'g1 Vkh sōdwr up f dq eh xvhg vlqf kur qrxvd lq vkr uōvhu p idf hōv ãdf h p hhvqj v w vxssr uvkdvhg jurxs ghflvrq p dnlqj 1 Lw f dq dōr eh xvhg lqglvgx dō dqq ylwx dōd ir u o qj 0 vhu p gvdō j dvk hūlqj sur r hf w/ ir ulqvãd qf h/ e l j hr j u dsklf dōd glvshuhg fr p sdqlhv1

Lq vklv fdvh vwxg l/ vkh z r unvkr s sduwf lsdqw z huh lqylvng w dq lqqr gxho vhwlrq w dqvz hu vkdvhg t xhwlr qv1 Lq vklv fdvh/ vkh t xhwlr qv lqyr qyhg vkh 53 uhvduf k lghdv eudlqwr up hg hduhu/ dqq w yr vhr i ur vkhlu suhihuhg lghdv1 Vkh vhwlrq z dv r uj dqlvhg gxulqj vkh idf hōv ãdf h z r unvkr s 1 Dv vkh ehj lqqlqj ri vkh lqqr gxho vhwlrq/ vkh z r unvkr s sduwf lsdqw z huh jlyhq dq r sssr uwxqlv w dgg p ruh uhvduf k lghdv/ dqq dōr j hvkhu ir xu ð7, qhz uhvduf k lghdv dsshdvhg r q vkh dj hqgd1 Lq vkh qh{wskdvh/ vkh 57 uhvduf k lghdv idf hg rii dj dlqvw hdfk r vku lq udqgrp d ir up hg sdlw lq vkh glj lwdō duhd/ z khuhq vkh sduwf lsdqw z huh dvhng w fkr r vh vkhlu suhihuhg dqvz hu1 Ehir uh yr vqj r q hdf k dqvz hu/ vkh sduwf lsdqw glvf xvvhg vkh yr vqj f uvdud/ iudp hg e l

uhuhqf h w vkh sur r hf w j r dō/ dqq vkh uhvduf k vwdvñj | ri vkh kljkhu hgxf dvr q lqvwxvwr q1 Vyhudo t xddvhwlvq dqq ydōxv z huh lghqwlhng dv ehqj p hdqlqj ixo ir u uhvduf k lghdv dqq ghflvrq p dnlqj lq vkh ghedvñ/ p r w lp sr uvdqvd l w vxvãlq deldōv/ lqqr ydvlvqhvw ðq' yhōv/ / ihdvleldōv/ xvhi xōhv w/ dqq vf dōdeldōv 1

Dv d uhvãvri vkh yr vqj / Lqqr gxho r iihuhg d sur ulvvhg dōvri dō vkh uhvduf k lghdv1 Vkh udnlqj r ughu z dv edvhg r q vkh z lq udvñ shuf hqvdj h ir u dqvz huw lq vkh glj lwdō duhd1 Z lvk lqqr gxho v udnlqj dō r u vkr p / vkh sduwf lsdqw glgq wkdv w jr vkr xj k hyhu srwledh dqvz hu shup xvãvwr q w ilqg vkh udnlqj r ughu1 Lqvhdōg/ vkh ilqdo udnlqj r ughu uhi dōf vng vkh fr ãhf vlyh r slq r q uhsuhvqhng ri dōs sduwf lsdqw1

Vkh ilyp r vwsr xōdu uhvduf k lghdv vkdwhp huj hg iur p vkh lqqr gxho sur ulv} dvr q z huh/ 4, Jur z lqj duf wf sōdqw lq d fr qvr ãhg hqylur qp hqwlqf αglqj vkh xvhr i qhz frpsrxqgv/ ylvdplqv dqq irrg sōdqw/ 5, Dqvlp l fur eldōlqj uhlhqw lq sōdqw/ 6, Krz fxōv dvr q frqglvr qv hiihf w sōdqw z khq rsvlp lvtqj vrp h sur shu vhw/ dñh sōdqw dvr { lgdqw/ 7, Ruj dqlf fr σ xv/ dqq 8, Jur z lqj ixqf vwr qdop r dñf xōdv vxlvledh ir u vsdf h vdyhd

Ryhudō vkh z r unvkr s p hp ehw h{ suhvvhg vdvvidf vwr q uhj duglqj vkh z r unvkr s v uhvãw1 Z khq dvhng ir u ihgedf n lp p hglvdhō divhu xvlqj vkh lqqr gxho wr d vvhudo sduwf lsdqw h{ suhvvhg vdvvidf vwr q ryhu vhlqj vkhlu uhvduf k lghdv udqnhg lq d fr qf u vñ dōv ir up 1 P r uhr yhu/ p r vwz huh kdss l w vhh z kdvwkdsh vkh ðw s dōv kdg vdhq1 Vrp h vvhvvhg vkdw vkh udqnhg uhvãw uhi dōf vng d vqdsvkr wri vkh vshflilf/ t xlvh vp dōj ur xs j dvk hūng dvkdvwl p h1 Vē r ri vkh uhvduf khw h{ suhvvhg uhj uhvkdvuhvduf k lghdv z lvk dq h{ s dflw f dō dñh dqq vxvãlq deldōv ir fxv kdg qrw p dgh lwlqvw vkh w s 81 Vklv z dv shukds vrp hz kdvwxs ulvlqj / jlyhq vkh uhdvlyhd p ruh sur p lqhqw ir fxv vxvãlq deldōv lvxhv kdg uhf hlyhg lq vkh uhvduf k hu h{ shf vãvwr qv dv vxuyh l hg lq vkh lqvhuylh z v1 Krz hyhu/ vkh uhvduf khw dōr yr lf hg vkdw vkh w r o kdg sxvkhg vkh p w z dugv fkr r vlqj fr qf u vñ dqq sudf wf do lghdv ryhu p ruh devvãf wr qhv/ z klfk fr xōg h{ sōd lq vkh σ z hu udnlqj ri p dql p ruh devvãf w f dō dñh 0 u hqvhng sur sr v dō1

Z klō sduwf lsdqw ylhz hg vkh glj lwdō sōdwr up dv d frqyhq l hqw r r o w khas p ryh iur p glyhvj lqj lghdwr q w z dugv d fr qyhj hqf h ri vr u w/ vrp h vñqvh glvf r xuvh hp huj hg lq vkh jurxs fr qf huqlqj vshflilf dōd vkh sudf wf do lp sōp hqvdwr q dqq ixqgd p hqvdō ydōxv ehklqg vkh uhvduf k lghdv ðōp ehj hwdō/ 5353, 1 l ru

Kr z w Glj lwdō Hqkdqf h Elr hf r qrp | Fr oader udwr q=P xwglv f lsdqduj Uvhduf k Whdp Lghdwr q ir uWhf kqr σ j | Lqqr ydwr q Fttj Szn jo-Mvsv Mn cf sh' Boovl l b Ql bsjof o

lqwdqf h/ vrp h lqvhuylhzhhv dij xhg vkw dw uhvduf k
lqvuhvw vkrxg sulp dūđ vxssruw σ qj 0vhu
vxwllqdelōw jr dōv zlvk vrf lhdōlp sdf w/ z klōn r vkhu
wuhwhg vkh vkr u0vhu uhvaw dgg qhgh ir ulp p hglvhu
ehqhilw iru σfdo exvlqhwvhv1 Lq dgh zlvk vkh
frqf αvraqv ri Vkr r w Xlvhu d p s dgg Yōn +533: ./
sulf vflqj p xwglv f lsdqduj/ ehvghv lw j uhdwehghilw/
dōr dsshduhg w eht xlvh f kdōh q lqj dgg fr p sdf dvhg1

Vkh zrunvks sduwf lsdq w lq rxu uhvduf k zrunhg
wj hvkhu r q d fr p sō{ rērf wri df vlylv/ uhilqaj vkhu
mlq w uhvduf k lqvuhvw dgg lghd v r q vp duw yhuwf do
idup lqj 1Rxut xddvōlvh d qdđ vl v ri vk h j u r x s glv f xwlr q
vxjj h w w v k d w v k h s d u w f l s d q w / i r o z l a j v k h l g h d r i
Hg z dugv +5343/ 5345/ 534: ./ h{ huf lvhg s f r b j p o b m b h f o d z
lq vk h l u h q g h d y r x u w h { s d q v k h l u l q v h u s u h v d w r q v r i
uhvduf k lghd v1 Vkh| glg v k l v e l e u q j l a j w e h d u v k h
y d ū r x v h { s h u w h d a g f r q f h s v d o u h v x u f h v r i i h u g e l
f r o d h j x h v i u r p g l i i h u h q w g l v f l s d q d ū g r p d l q v l q v k h
z r u n v k s 1 l q v k h l u m l q w l g h d w r q / s d u w f l s d q w
u h f r j q l v h g i x u k h u d v s h f w r i u h v d u f k d v s r v l e l d w h v w
z r u n r q 1 V k h l u z l g h u l q v h u s u h v d w r q v r i v k h u h v d u f k
s r v l e l d w h v g u h z r q v k h w h q j v k v r i f r o a d e r u d w u i u r p
v k h g l i i h u h q w g l v f l s d q h v 1

Vkh zrunvks p hp ehv d s p t t f e e j t d j r j o b s z c p v o e b s j f t
lq fr o a d e r u d w y h l g h d w r q / t i b s f e l o p x r f e h f i u r p v k h u
x q l t x h l q i r u p d w r q d o w d q g s r l q w d a g j o u f h s b u f e
l o p x r f e h f e l f r p e l q l a j s h u s h f v y h v i u r p y d ū r x v
g l v f l s d q h v l q v k h u d q n l a j s u r f h w v x s s r u w g e l v k h
l q q r g x h o s a d w r u p 1 V k h l q v h u z l q h g s u r f h w h v g x u l a j
v k h z r u n v k s h f k r h g v k u h s k d v h r x w r i l r a j v +5336,
i l y h s u r f h w h v r i n a r z d o g j h f u h d w r q = e r x a g d ū 0
f u r v l a j / n a r z d o g j h 0 v k d ū l a j / d a g n a r z d o g j h
l q v h j u d w r q 1 D a l q v h u h v l a j t x h w r q i r u v k h
l p s d h p h q v d w r q s k d v h r i v k h u h v d u f k u h p d l q v = z l o
v k h u h d o r e h s u r f h w h v l q q h z n a r z d o g j h j h q h u d w r q
d a g f r o d h v y h s u r r h f w d h u l a j v k d w d ū v h i r u v k h v p d u w
y h u w f d o i d u p l a j s u r r h f w a d w h B

Nhslqj vkh qxp ehu ri zrunvks sduwf lsdq w vp dō
vhhp hg w lqf uhdv r s s r u x q l w h v i r u s d u w f l s d q w w
f r q v l e x v h w g l v f x w l r q 1 L u d o r j h q h u d w h g p r u h f k d q f h v
w v a d s l q w d e u r d g g l y h u w y r i s h u s h f v y h v / d v S d x o v /
E d u x d k / d a g N h q z r u w k | +534; , v x j j h w h g 1 L q v h u h v l a j d /
v k h p h v k r g r i v k d ū l a j l g h d v l q l q q r g x h d z r u n l a j
l a g l y l g x d a j z k l o n d o r v l q f k u r q r x v d r q l g h d
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h { s h u h q f h l q i d f h 0 w Q d f h j u r x s g l v f x w l r q v 1 V p l a d u w
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v k h e h w r i v k h s k | v f d o d a g g l j l v d o z r u g v v h p h g l q r x u
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p xwglv f l s d q d ū v h d p / z k l o n v x s s r u w l a j v k h v h d p l a
i u d p l a j d a g s u r u v w l a j v k h l u u h v d u f k l q v h u h v w 1

32' 086-326

Fr qvnp srudj fkdōh q hv ri hfr σ j l f do vxwllqdelōw
ghp dgg p xwglv f l s d q d ū f r o a d e r u d w r q 1 R x u u h v x o w
l a g l f d v h v k d w p x w g l v f l s d q d ū f r o a d e r u d w r q r i i h u v
p x o l O y r l f h g d o h u q d v y h v w u h v d u f k / v h f k q r σ j l f d o
g h y h o s p h a w d a g l a q r y d w r q s u r f h w h v / d v z h o d v
r s s r u x q l w h v i r u h { h u f l v l a j u h o d w r q d o d j h a f | 1 K r z h y h /
l q s u d f v f l h / v h y h u d o f k d o h q j h v u h p d l q / i r u l q w d q f h /
e x l o l a j u r r p i r u f r o a d e r u d w r q e h v z h h q u h v d u f k h u v
d a g g h f l g l a j r q d - v k d u h g r e r f w - D a ū h) Q r h / 5347, r u
u h v d u f k l g h d 1

Z h i l a g l w l p s r u d q w v k d w p x w g l v f l s d q d ū d f w u e h
r i i h u g v x s s r u w l q e x l o l a j u h o d w r q d o d j h a f | 1 D v
u h o d w r q d o d j h a f | g h y h o s v e h v z h h q d f w u / p r u h
u h d y d a w d v s h f w r i v k h s k h a r p h a r q x a g h u
l a y h w j d w r q f d a e h u h f r j q l v h g d a g z r u n h g r q 1 V k l v
h a f r x u d j h v q r w r a d v k h g h y h o s p h a w r i q h z
v h f k q r σ j | / e x w e u r d g h u v f l r 0 v f k a l f d o v a d q v l w r q v d a g
e h w h u p d a j h p h a w r i v k h f r q v h { v x d d v d w r q d a g
l p s d h p h q v d w r q r i v h f k q r σ j l f d o l a q r y d w r q 1 D w l w e h w /
g l j l w d o v x s s r u w f r p e l q h v j u r x s h { s h u w h d a g l a g l y l g x d o
f r p s h v n q f h w f u h d v h q h z y l h z s r l a w d a g
x q i r u h v h d e d v r o w r q v 1

Vkh uhvaw ri v k l v s d s h u l a g l f d v h v k d w g l j l w d o s a d w r u p v
p d l r i i h u d q l p s d f v i x d s u r f h w d f f h d u d w a j v x s s r u w l q
v k h n l n 0 r i i s k d v h r i p x w g l v f l s d q d ū v h f k q r σ j l f d o
l a q r y d w r q v 1 V k h x v h r i g l j l w d o s u r u w j d w r q e l u d q n l a j
v k u r x j k y r v a j p d l e h s d u w f x a d ū k h o s i x o z k h q
q h h g l a j w v k l i w f r q y h u d w r q v d z d l i u r p v k h d e w u d f w w
d p r u h s u d f v f l d a j r u h q v h g d y h d V k h v h d f w r q s u r f h w
r i y r v a j i r u f h v s d u w f l s d q w w p d n h f k r l f h v e h v z h h q
d a d e x a g d q d f h r i d o h u q d v y h v 1 Z h v k x v e h d y h v k d w
g l j l w d o s a d w r u p v f d a v x s s r u w l g h d w r q d a g v k h
s ū r u v d w r q r i l g h d v / l q d z d l v k d w f d a g e h h v s h f l d a j
i u x l w x o z k h q s d l u h g z l v k i d f h w i d f h g l v f x w l r q d a g
q r q o g l j l w d o l q v h u d f w r q 1

' / 23: 0 (+ 1) 276

Z h z r x g d n h w v k d a n O x e r y Y h w v k n l a d i r u k h u
f r q v l e x v h q l q g h v l j q l a j v k h l q v h u y l h z v d a g f r o d h v a j
l q v h u y l h z g d v d 1

Kr z w Glj lwd0 Hgkdqf h Elr hf r qrp | Fr oader udwr q=P xwglv f lsdqduj Uvhduf k
Whdp Lghdwr q ir uWhf kqr σ j | Lqqr ydwr q Fttj Szzn jo-Movsb Mn cf sh' Boovl l b Qbl bsjof o

)*)5)2')6

D0Fkd0el/(P 1 53481 Yhuwf do idup lqj =
Vnl vf udshu(vxw0lqdel0wB Tvtubjobcrh Djyft boe
Tpdjfuz/4; = 70: 81
(kws v=22gr l f u j 243143492nfv53481391336)

Da0h/ K11') Qrh/ H1 53471 Vhfr qg0r ughu vf lhqf h ri
lqvwglv f lsdqduj uhvduf k d sr d r f x0diudp hz r un ir u
z lfnhg sur edp v1 Dpotusvdjwju Gpvobypot/ 43+4, =
980: 91

Dxhuedf k/ F1) M0ghuwhlq/ OE153361 Rvbrjubjwf Ehub;
Bo Jouspevdjpo up Dpejoh boe Bobratjt/ Qhz \ r un
Xqlyhuwlv Suhw=Sur TxhwhHerr n Fhqwd0d

Ghqqlv/ D1U1 P lqdv/ U1 N1 Z l0dp v/ P 1 O1 534<1
Fuhdwlwv lq Frp sxvhu0P hgl0vng Ylwx do J ur xsv1 Lq
SE1 Sdx0v) E1D1 Qlrv0dg +Hgv1/ Uif Pyg0se
l boecppl pg Hspvq Dsf b0jwuz; Jopvbypo u spvhi
Dprbcpsbjpo/ R{ir ug Xqlyhuwlv Suhw1

Hgz dugv/ D1 53431 Cfjoh bo Fyqfsu Qspg0ttjopbm
Qsb0jyopfs; Uif Sfr0bjopbm Uvso jo Fyqfsjft/
Gr uguhf kw=Vsulqj hul

Hgz dugv/ D1 53451 Wkh ur ch ri frp pr q nqr z d0gj h lq
df klhylqj fr oader udwr q df ur w sudf wf hv1 Mfbs0joh-
Dvrvsf boe Tpdj bmbuf sb0jpo-4+4, =550651

Hgz dugv/ D1 534: 1 Uha0wr qdo H{shuwh= D Fx0xud0
Klwr uf doDs sur df k w Whdf khu Hgxf d0wr q1Lq Shvhuw/
P 1D1 Frz lh/ E1) P hqwhu/ L1 +Hgv, 1 B Dpn qbojpo up
Sftfbsdi jo Ufba fs Fevd0jpo/ Mqj dsr uh= Vsulqj hu=
888089: 1

I r qj/ SMZ 1 53361 Nqrz d0gj h fuhdwr q lq
p x0wglv f lsdqduj sur rhf wvndp v=dq hp sluf dovwx gl ri
vkh sur fhvhwv d0g vkhu gl qdp lf lqvwu0ha0wr qvklsv1
Juf sob0jopbm0fv sobmpg Qspk duN bobhf n fou 54=7: <0
7; 91

J h0w/ lZ 1 53441 Wkh p x0w0d0yho shushf wvh r q
vxw0lqdel0wv w0dqv1wr qv= Uhsr qvhv w vhyhq
fufwlv v1 Fowj0pon f0ubm Jopvbypo boe Tpdj f0ubm
U0botj0jpot/ 4+4, =570731
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ri vkh P x0w0d0yho Shushf wvh1 Dvssf ou Pqj0jpo jo
Fowj0pon f0ubm Tvtubjobcjrjuz/ 6<=4; : 0341
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n bl joh n bef fbtz/ Uhw0lhyhg Vhsvhp ehu; / 5353 iur p
kws v=22z z z 1qqr gxh0f r p 2hq2sur gxf w

Mqvhq/ P P 1 Wklh0 V1 Krj j dq/ H1) E0gnhu/ V1 534: 1
Sk| v f do Yhuwxv Glj lwd0 Wf n| Qr vhw lq Fr oader udwvh
Lghdwr q1 Dpn qvuf s Tvqapsufe Dppqf sbjwf Xpsl / 5: =
93<09781

Nhuw/ G1V1) P xwk| / X 1/ 533<1 Eh| r qg eudlqvw up lqj =
Wkh hiihf wvhqhw ri frp sxvhu0P hgl0vng
frp p x0lfd0wr q iru frqyhj hqf h d0g qhjr w0dwr q
v0v0v1 Juf sob0jopbm0fv sobmpg B0dpv0joh J0g0sn bjpo
Tztuf n t/ 43+7, =57805951

Nr ugh/ U1) Sdx0v/ SE1534: 1 D0h0ud0wqj lqglylgx d0d0g
j ur xs lghd j hghdwr q=l lgl0aj vkh h0xvlyh vl qhuj | 1
0fv sobmpg Fyqfsjn f0ubm Tpdj bmb0 Qzdi prphz/ : 3=4: : 0
4<31

Nxkq/ WM14<951 Uif Tusvdwv sf pg T0j f0ujgd Sf wpr0jpot/
Fklfdj r=Xqlyhuwlv ri Fklfdj r Suhw1

Odaj/ G1V1 Z lhn/ D1 Ehuj p d0q/ P 1 W0xiiidf khu/ P 1
P d0h0q/ S1 Pr0 S1 Vz l0d0j/ P 1) Wkrp dv/ F1M
53451 W0d0vglv f lsdqduj uhvduf k lq vxw0lqdel0wv
v f lhqf h= sudf wf h/ suqf lsd0v/ d0g fkd0h0j hv1
Tvtubjobcjrjuz T0j f0df = / 580761

Qdp ehuj / O1 U| | p lq/ H1 Sddyr 0d/ V1 Yhw vknlq0/ O153531
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P d0xvf usw0q suhsdudwr q1

Qr ulv/ S1H1 R*Ur xunh/ P 1 P d| hu/ VD1) Kdgr w0hq/ N1H1
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w0d0vglv f lsdqduj vndp ir up d0wr q lq vrf lr 0hfr σ j lf do
vl w0p v1 M0et0b0f boe Vscbo Q0bo0joh/ 487= 4480
4551

Sdx0v/ SE1 Edu0k/ M) Nhqz ruw| / ME1 534: 1
Hqkd0flqj Fr oader udwvh Lghdwr q lq Ruj d0j} d0wr qv1
Qsp0jfst jo Qzdi prphz/ <=53571

Srk0 F1 d0g Klwfk Kdgr uq/ J 1 533: 1 Qsj0d0qrft g0s
Eftjoh0joh U0b0tejt0qjr0bsz Sftfbsdi 1 P 0yqf khq=
r hnr p yhu0j 1

Srk0 F1) Klwfk Kdgr uq/ J 1 533; 1 P hvkr gr σ j lf do
fkd0h0j hv ri w0d0vglv f lsdqduj uhvduf k1 Obw0sf t
T0j f0df t Tpdj 0u0t/ 49+5, =4444541

Udp dglhu/ VM 53371 W0d0vglv f lsdqduj d0g lw
fkd0h0j hv=Wkh f dvh ri xu0dq w0x gl hv1 Gv w0sf t/ 69+7, =
756076<1

Vfkr r wXlvndp s/ D1MP 1) Y0hn/ F1D1M 533: 1 Sudf wf h
d0g rxv0r phv ri p x0wglv f lsdqduj uhvduf k iru
hqylur qp hq0d0v vxw0lqdel0wv 10fv sobmpg Tpdj bmb0t vft/
96+4, =4: 804<: 1

Ylf n/ WH1 Qdj dqr/ P M1) Srsdglxn/ V1 53481
Lqir up d0wr q f x0xuh d0g lw lqixh0f hv lq nqr z d0gj h
fuhdwr q=Hylghqf h iur p xqlyhuwlv vndp v hqj dj hg lq
fr oader udwvh lqqr ydwr q sur rhf w1 Juf sob0jopbm
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\ dj r 0nr yvnl / V1U1 53481 Fuhdwlwv lq l df h0w 0l df h d0g
Frp sxvhu0P hgl0vng Eudlqvw up lqj 1 Sv| fkr σ j | 1
0fv sobmpg u f l jhi fs T0i pmpg F0p0pn jat/ 45 +7, =4; 70
4<41

Kr z w Glj lwd} Hqkdqf h Elr hfr qrp | Fr æter udwr q=P xatglvf lsdqduj Uvhvduf k
Whdp Lghdwr q ir uWhf kqr σ j | Lqqr ydwr q Fttj Szn jo-Mvsvb Mn cf sh' Boovl l b Ql bsjof o

&3877,) 87, 356

Gu1Hwl U| p lq kr æv d SkG lq Hgxf dwr qdoVf lhqf hv
iur p vkh Xqlyhuwly ri Wdp shuh +WKQL/ 533; ,1 Vkh
kdg khag vnyhudo hgxf dwr qdo vshf lddwv sur rhf w
p dqdj hu dqg U) G p dqdj hu sr vlwr qv lq vkh sxedf
dqg sulydvh vhf w ulq fr p shvqf h ghyhσ sp hqwdqg
vkh glj lwd} dwr q ri hgxf dwr q1 Vkh fxuuhqw df w dv
Suqf lsdouvhvduf k Vf lhqvwvlq Kçp h Xqlyhuwly ri
Dssdthg Vf lhqf hv dqg dhdgv vkh lxxvuh Z run
Uvhvduf k) Ghyhσ sp hqwWhdp zlvk d irfxv dqg
lqvuhvwr q h{ sσ ulqj vdwqvir up lqj z run/ ixvuh vnlæ
ri sur ihvwr qdo/ dqg fr qvwxr xv dduqlqj 1K huz runv
kdyh ehq sxedvkhg lq lqvuhvwr qdo mxuqda vxf k
dv F. rfbsojoh boe Fevdjypo- Dpn qv f s' Fevdjypo-
dqg Juf sobjyobm Kpsobm gōs Dsp tt. Ejt djqrjbsz
Tvckf dt jo Fevdjypo/

Qdxud Qdp ehj kr æv d p dwhuv ghj uhh lq Sr dwf do
Vf lhqf hv iur p vkh Xqlyhuwly ri Kholqnl +534; ,1
Qdp ehj z runv dv d sur rhf wuhvduf khudwvkh KDP N
Hgx uhvduf k xqlwdwKçp h Xqlyhuwly ri Dssdthg
Vf lhqf hv1 Khu fxuuhqw uhvduf k lqvuhvwr fryhu d
vfrsh ri vkh vrfldo vwxglhv ri vflhgf h dqg
whf kqr σ j // lqvuhvwr qdo vdwqvir up lqj z run/ ixvuh vnlæ
ri sur ihvwr qdo/ dqg fr qvwxr xv dduqlqj 1K huz runv
kdyh ehq sxedvkhg lq lqvuhvwr qdo mxuqda vxf k
dv F. rfbsojoh boe Fevdjypo- Dpn qv f s' Fevdjypo-
dqg Juf sobjyobm Kpsobm gōs Dsp tt. Ejt djqrjbsz
Tvckf dt jo Fevdjypo/

Gu1 Dqaxnnd Snduqhq kr æv d SkG lq
Hqylur qp hqwdō Vr αvr qv lq Dj uf xoxuh dqg d
p dwhuv ghj uhh lq Fkhp lf do Hqj lqhhdqj 1 Vkh kd
h{shuwh lq xwd} lqj dqg vhdwqj +sk| vlf dō
fkhp lf dō hq} p dwf / hv 1, sōqwdqg z dwh edvhg
udz p dwhudō lq elrixho sur gxf vwr q1 Fxuuhqw vkh
z runv dv vkh Gluhwuri KDP N Elr uhvduf k xqlw
fσ vhd ir æz lqj vkh ilhag ri Elr hfr qrp | iur p
sulp dū sur gxf vwr q w ydoxh dgghg uhilq lqj dqg
vp duvvr αvr qv1 Vkh kdvdōr ehq vkh ir xqghuri d
vduwxs fr p sdq lq vkh ilhag ri fluf xōduhfr qrp | 1

Fhvwr q=U| p lq/ Hf Qdp ehj / Of) Snduqhq/ D153531 Kr z w Glj lwd} Hqkdqf h Elr hfr qrp | Fr æter udwr q=P xatglvf lsdqduj Uvhvduf k Whdp Lghdwr q ir uWhf kqr σ j | Lqqr ydwr q1 Whf kqr σ j | Lqqr ydwr q P dqdj hp hqw Uhyllhz / 43+44, =6406<1 kws =2gr l f u 243 555482Wp uhyllhz 24734

Nh| z r ugvp= P xatglvf lsdqduj / glj lwd} hqkdqf hg vndp z run/ lghdwr q / vxwllqdelōw / whf kqr σ j lf dolqqr ydwr q1