

5 i Z'XYf'Gdi f'j cb'@YcdUfXYb'i bX ; YdUfXYb']a 'BUhi fgWXi hn[YV]Yh C_cb^]a Už'BUa]V]U

K]f VYgi WYb Y]bYb XYf k Y`hVYghYb C fhYži a ; YdUfXYb i bX @YcdUfXYb ni gY\Yb. XUg B Uhi fgW\i hn[YV]Yh C_cb']a U]b B Ua]V]U ⇒W V]b Y\f`]W\. H\YcfYh]gW\ a U[']W\ X]Y ⇒XYYŽ]b Y]bYf² _c!@cX[Y ni 'ØVYfbUW\hYb/⇒ XYf DfUI]g V]b]W\ YXcW\ b]W\hVY[Y]ghYfh'j cb XYf 5i gg]W\h'Ui Z'8fcd! Hc] YhhYbŽgW\k UW\Yb K UggYfXfi W_ŽgW\ YW\hY 6Y`ØZhi b[ŽX]Y U`Yg Y]b k Yb]['ZYi W\ha UW\hŽcXYf cZZYbY K AbXYŽX]Y ⇒gY_hYb Ni hf]hh [Yk A\fYb" 8]Yg _ObbhY Yf_`AfYbŽk Ufi a]W\ 'g_Ydh]gW\ [Y[YbØVYfY]bYa '5i ZYbh\U`h]a B Uhi fgW\i hn[YV]YhC_cb']a U`]b B Ua]V]U`k Uf" 5`g'J Yfk U`hYf XYf'B Uhi fgW\i hncf[Ub]gUh]cb '5Zf]7 Uhi]gh'C_cb']a U`[YbUi 'X]Y 5fh'j cb' C fhž'XYf'i bj c``_ca a YbY'9]bf]W\hi b[Yb'i bhYf'XYa 6UbYf'j cb' 8c]b['; ccX 'UbV]YhYb'_ObbhY"6Y]'XYf / Ua d∧Y``]d/

K]f`VYgi W\Yb`Y]bYb`XYf`k Y`hVYghYb`C fhYži a ; YdUfXYb`i bX@YcdUfXYb`ni `gY\Yb.`XUg`BUhi fgW\i hn[YV]Yh`C_cb^]a U`]bBUa]V]U

 $\begin{array}{l} \exists W. \ V]b \ Y \setminus f`]WX . \ H \setminus Y c f Y h]gWX \ a \ U[\]WX \ X]Y \ \exists X Y Y \check{z} \]b \ Y]b Y f ^2 \ _c!@c X[\ Y ni \ "ØVYfb UWX hY b /" \beta \ XY f `Df UI \]g \ V]b \]WX \ `Y X c WX \ 'b]WX h V Y [\ Y]ghY f h'j \ c b XY f `5 i gg]WX h `Ui Z'8 f c d! H c] `Y h h Y b \check{z} gWX k UWX Y b `K UggY f X f i W_ \check{z} gWX `Y WX h Y `6 Y `ØZhi b [\check{z}'X]Y `U``Y g Y]b `k Y b][`ZY i WX h a UWX h \check{z}'c X Y f c ZZY b Y `K \Ab X Y \check{z}'X]Y \ \beta g Y _h Y b `N i h f]h h `[Y k \A\ f Y b " 8] Y g `_\Obb h Y Y f _`Af Y b \\check{z}'k U f i a `] WX `g _ Y d h] gWX `[Y [Y b Ø V Y f Y] b Y a `5 i Z Y b h \ U`h`] a B U h i f gWX i h n [Y V] Y h `C _ c b ^a U `] b `B U a] V] U `k U f " \end{align*}$

5`g'JYfkU`hYf'XYf'BUhi fgW\i hncf[Ub]gUh]cb'5\Zf]7Uh']gh'C_cb']aU [YbUi 'X]Y'5fh'j cb'Cfh\Z'XYf'i bj c``_ca a YbY'9]bf]W\hi b[Yb'i bhYf 6Y]'XYf'5b_i bZh'k i fXY'a]f'YXcW\'_`Ufž'k]Y'ZU`gW\']W\'`U["
C_cb']a U'`]Y[h'Ua 'Ca Vcfc_c!; YV]f[Y'Ui g'GUbXghY]b'i bX'V]YhYh
`i I i f]ÒgY'I bhYf_ØbZhY']b'XYf'UV[Y`Y[YbYb'K]`Xb]g'gY]bYg
Y][YbYb'BUhi fgW\i hn[YV]Yhg''<c\Y'8YW_Ybž'ZfY][Y`Y[hYg
A Ui Yfk Yf_'i bX'Ui g[YZU``YbYg'\DXi ghf]YXY_cf'gW\UZZYb'Y]bY
`i Zh][Yž'cZZYbY'5ha cgd\AfYž'X]Y'k Y]h'j cb'XYa 'YbhZYfbh']ghž'k Ug
]W\'Yfk UfhYh'\UhhY"

9gʻ]ghʻUʻgcʻZUghʻni ZÀ``][žʻXUggʻg]W\ʻC_cbʻ]a UʻgcʻghUf_ʻZØfʻXYb B Uhi fgW\i hnʻYb[U[]Yfh"8]YʻK U\f\Y]hʻ]ghžʻXUggʻYgʻUi ZʻXYfʻUbXYfYb GY]hYʻXYgʻB Uhi fgW\i hn_Ua dZYgʻVY[Ubb. '8 Ugʻ\Y]» hžʻUʻgʻ5 W_Yf`UbX]a '6Yg]hnʻj cbʻF cgYʻi bXʻJ >< UbggYbžʻX]Yʻg]W\ʻXcfhʻ%- +\$ b]YXYf`]Y» Yb"'8]Yʻ: Ua]`]Yʻ< UbggYbʻnØW\hYhYʻ6fU\a Ub!F]bXYfʻi bX Yf`]hhʻk]YʻUbXYfYʻ@UbXk]fhYʻJ Yf`i ghYʻXi fW\ʻ: `Y]gW\ZfYggYf"

BUa]V]U'VY\Y]a UhYh'X]Y'k Y`hk Y]h'[fÒ» hY'ZfY]`Ui ZYbXY; YdUfXYbdcdi `Uh]cbž'UVYf'Ui Z[fi bX'XYf'_ca a Yfn]Y``Yb@UbXk]fhgW\UZh'i bX'XYg'gh\AXh]gW\Yb'9]b[f]ZZg']b'k]`XY@YVYbgf\Aia Y'k U[Yb'g]W\; YdUfXYb'i bX'@YcdUfXYb'cZh'Ui Z'X]Yfi bX'+"\$\$\$'_ca a Yfn]Y``Yb': Ufa Yb'XYg'@UbXYg"

"U`h1 @YcdUfXYb`k YfXYb`Ui g`gWk]bXYbXYb`@YVYbgfÀi a Yb`Ui Z
5W_Yf`UbX`[Ynk i b[Yb 25h`Ug'/ '6cchg'GWkfi a dZYbXY
@YVYbgfÀi a Y`\UVYb`@YcdUfXYb`Ui Z'5W_Yf`UbX`[Ynk i b[Yb

8]Y'<UbggYbg'j Yfgi W\hYbž'k]Y'UbXYfY'6Ui Yfb'Ui W\ž']\fY `UbXk]fhgW\UZh`]W\Yb'JYf`i ghY'ni 'a]bXYfbž']bXYa 'g]Y'@YcdUfXYb Y]bZ]b[Ybž'YfgW\cggYb'i bX''\[hYb"'8]Yg'\UhhY'k Yb][5i gk]f_i b[Yb.'8Yf'JYf`i gh'j cb'&\$'V]g'' \$'?Ø\Yb'dfc'\\f XYn]a]YfhY']\fY'<YfXYb'i bX'ZØ\fhY'ni 'YfXfØW_YbXYb'Z]bUbn]Y``Yb JYf`i ghYbž'Y]bY'G]hi Uh]cbž'X]Y'_`Y]bYfY'6Yhf]YVY'bcW\'ghÀf_Yf'hfUZ" 8]Y < UbggYbg Yf[ÀbnhYb]\f 9]b_ca a Ybž]bXYa 'g]Y Hfcd\ÀYb 'À[Yf ØVYf]\fY 5bVUi ZÀWXY a]hbU\a Yb"

5b[Yg]Wkhg'X]YgYg'?fY]g`Ui Zg' '8Yn]a]Yfi b['i bX'HcXž@UbXj YfÒXi b['i bX'YbhgYhn`]WkY'NYfghÒfi b['[fc»Yf': `Y]gWkZfYggYf'j YfdZ]WkhYhYb'g]Wk'X]Y'?]bXYf'XYf'<UbggYbgž'K UmbYž'HUa a mž FcgY`YU'i bX'8cbbUž'Yg'VYggYf'ni 'a UWkYb"

8]Y: Ua]`]Y'< UbggYb'j Yf`U[YfhY']\fYb': c_i g'fUX]_U`'j cb'XYf @UbXk]fhgW\UZh']b'C_cb']a U'Ui Z'X]Y'GW\UZZi b['Y]bYg'&\$\$'_a & [fc»Yb'df]j UhYb'BUhi fgW\i hn[YV]Yhg"'\text{f'N]Y`'k Uf'Ygž'XUg'@UbX k]YXYf'gc'ni 'a UW\Ybž'k]Y'Yg'Y]bgh'Ui ggU\ž'i bX'@YcdUfXYb'i bX; YdUfXYbž'X]Y'Ui Z'5W_Yf`UbX'[Ynk i b[Yb'k i fXYbž'j cf gW\k]bXYbXYb'@YVYbgfÀi a Yb'ni 'gW\ØhnYb"

"U`h1 5Zf]7Uh'ZÒfXYfh'Y]bY'?i `hi f'XYg'Ni gUa a Yb`YVYbg']a
BUhi fgW\i hn[YV]Yh'C_cb']a U 25h`Ug'/ '6cchg'5Zf]7Uh'ZÒfXYfh'Y]bY
?i `hi f'XYg'A]hY]bUbXYfg

I a 'Y]bY'?i `hi f'XYg'Ni gUa a Yb`YVYbg'ni 'ZÒfXYfbž'[fØbXYhYb'X]Y < UbggYbg'%- - %'X]Y'5Zf]7Uh': ci bXUh]cbž'i a 'XYb'HYi ZY`g_fY]g @YcdUfX'hÒhYh'?i \ž'6Ui Yf'hÒhYh'@YcdUfX 'ni 'Xi fW\VfYW\Yb"

5`g`HY]``gY]bYf`5i Z[UVYb`V]`XYh`5Zf]7Uh`@UbXk]fhY`i bX`GW\i`_]bXYf Ui gž'j YfZc`[h': `Y]gW\ZfYggYf`i bX`k Ufbh`@UbXk]fhYž'J]Y\`ni gUa a Y`bž'k Ybb`a Ub`]\bYb`ni `bU\Y`_ca a hž'i bX`gUa a Y`h : `Y]gW\ZfYggYfž'X]Y`gcbgh'j cb`@UbXk]fhYb`[YhÒhYh`k ØfXYb"

6]g`\Yi hY`\Uh`5Zf]7Uh`a Y\f`U`g`%"\$, \$`[fc»Y`: `Y]gW\ZfYggYf

[YfYhhYhi bX`ZfY][Y`UggYbž'k Ug`, *`i `XYf`H]YfY`Ui ga UW\hž`X]Y

Xi fW\gY]bY`<\AbXY`[Y[Ub[Yb`g]bX"\8]YYb][Ybž`X]Y`Ui g

j YfgW\]YXYbYb`; fØbXYb`b]W\h`fY\UV]`]h]Yfh`k YfXYb`_\ObbYbž

k YfXYb`Ufh[YfYW\h`Ui Z[Ync[Yb"\8]Yg`]gh`Y]b`bchk YbX][Yf`HY]``XYf

5fVY]h`XYf`Gh]Zhi b[ž`UVYf`XYbbcW\Yf[fY]ZYbX"`GW\`]Y»`]W\

VYnY]W\bYh` 5Zf]7Uh `b]W\h`bi f`Y]bY`UZf]_Ub]gW\Y`?UhnYž`k]Y`]W\

ni Yfgh`XUW\hYž`gcbXYfb`Y]bY`ZfY]Y`?UhnY` `XUg`i`h]a Uh]j Y`N]Y``XYf

Gh]Zhi b[ž`X]Y`FYhhi b[`j cb`: `Y]gW\ZfYqqYfb"

TU`h1 8 UgʻB Uhi fgWki hn[YV]YhʻC_cbʻ]a Uʻ]ghʻY]bYfʻXYfʻVYghYbʻCfhY XYfʻK Y`hžʻi a ʻ@YcdUfXYbʻni ʻVYcVUWkhYb 2 5h`Ugʻ/ ʻ6cchgʻ8 Ug B Uhi fgWki hn[YV]YhʻC_cbʻ]a Uʻ]ghʻY]bYfʻXYfʻVYghYbʻCfhYʻXYfʻK Y`hži a ʻ@YcdUfXYbʻni ʻVYcVUWkhYb

K]f`\UhhYb`bi f`Y]bY`BUW\h`]b`C_cb^]a U`[Ubn`Ua `9bXY`i bgYfYf GY`VghZU\fYf!GUZUf]`Xi fW\`BUa]V]U`i bX`VYgW\`cggYbž'5Zf]7Uh`ni VYgi W\Ybž'i a `a Y\f`ØVYf`gY]bY`5fVY]h`ni `YfZU\fYb`i bX`gY]bY ?UhnYb`Ui g`XYf`BÀ\Y`ni `gY\Yb"

8 UgʻYfghYž'k Ugʻa]fʻVY]ʻ5 Zf]7 UhʻUi ZZ]Yʻž'k UfʻY]bYʻ[fc» Yʻ\Àb[YbXY ? UfhYž'X]Yʻj YfUbgWk Uiʻ]Wk hYž'k]Yʻj]YʻYʻ: Ufa YbʻXUgʻF YgYfj Uhia [YVYb"ʻ?Y]bʻK i bXYfžʻXUggʻg]WkʻX]YʻH]YfYʻUi Zʻ5 W_YfʻUbX j Yf]ffYb"ʻ8 UgʻNYbhfi aʻ]ghʻj cʻʻj cbʻÀ\bʻ]WkʻUi ZZÀʻʻ][Yb FYggci fWYb"ʻ=bʻY]bYaʻUbXYfYbʻ5 VgWkb]hhʻVYZ]bXYhʻg]WkʻY]bY GUa aʻib[ʻj cbʻ8 cgYbž'X]YʻXUgʻYa dZ]bX`]WkYʻ; ʻY]Wk[Yk]WkhʻXYg @YVYbgʻUi ZʻXYfʻ9fXYʻXYa cbghf]YfYb"

'U`h1 8Ya cbghf]Yfh'XUg'Ya dZ]bX`]W\Y'; `Y]W\[Yk]W\h'XYg'@YVYbg\Z\
C_cb']a U'BUhi fY'FYgYfj Y 25h`Ug'/ '6cchg'8Ya cbghfUh]cb'XYg
Ya dZ]bX`]W\Yb'; `Y]W\[Yk]W\hg'XYg'@YVYbg

I bgYf: Ø\fYfž'A Ufh]bž'dZØW_hY'X]Y'cVYfY'8cgY'j cb'XYf'Ghfi _hi f" K Ybb'A YbgWXYb'j YfgWXk]bXYbž'[Y\h'XYf'FYgh'XYg'@YVYbg k Y]hYf ž'gU[hY'Yf"'9f'XYi hYhY'Ui Z'Y]bY'b]YXf][YfY'8cgY"' K Ybb YXcWX'Cfml'i bX'; bi g'j YfgWXk]bXYbž'_ÒbbhYb'Ui WX'@YcdUfX'i bX; YdUfX'j YfgWXk]bXYb" '9g'k Uf'Y]bY'J YfY]bZUWXi b[ž'UVYf'Ui WX Y]b'YZZY_h]j Yf'K Y[ž'i a 'XYb'GWX@Yfb'i bgYfYb'D'Uhn']b'XYf'?YhhY i bX'XYb'GWXUXYbž'XYb'k]f'XYbYb'i bhYf'i bg'ni ZØ[Ybž'ni XYa cbghf]YfYb"

6U`X`a UW\hYb`k]f`i bg`Ui Z`X]Y`Gi W\Y`bUW\`9`YWhfUž`Y]bYa
ZfY]`Ui ZYbXYb`@YcdUfXYbž`XYf`j cb`5Zf]7Uh`Ui Z[YgdØfh`k i fXY"
9`YWhfU`hfÀ[h`Y]b`<U`gVUbXž`XUa]h`: cfgW\Yf`X]Y
6Yk Y[i b[ga i ghYf`j cb`; fc»_UhnYb`UbU`mg]YfYb`i bX`@UbXk]fhYk UfbYb`_ObbYbž`k Ybb`a Ub`Y]bYf`; fYbnY`ni `bU\Y`_ca a h"
@UbXk]fhYb`ni `Yfa O[`]W\Ybž`]\f`J]Y\`Y]bni nAi bYbž`\]bXYfh`g]Y
XUfUbž`Y]bY`? UhnY`ni `hOhYb"

K]f'VYcVUW\hYhYb'Y]bY'k i bXYfVUfY'8 UfghY``i b['j cb'9`YWhfUg Gc\bžXYf'ni a 'Gd]Y`Yb'\YfØVYf_Ua 'fl bX'g]Y'n]Ya `]W\'`Ui b]gW\
fYU[]YfhY\!''9g'k Uf'_`Ufž'XUgg'XUg'BUhi fgW\i hn[YV]Yh'C_cb']a U
Y]bYf'XYf'VYghYb'CfhY'XYf'K Y`h']ghž'i a '@YcdUfXYb'i bX'; YdUfXYb
ni 'gY\Yb"'BUhØf`]W\']gh'X]fY_hY'\DhYfU_h]cb'ghfYb[ghYbg'j YfVchYb
i bX'6YcVUW\hYf'a ØggYb'Ui g'XYf': YfbY'ni gY\Yb"
B]W\hgXYghchfchn']gh'X]Y'9fZU\fi b['[YfUXYni 'a U[]gW\"

8 Ub UW. 'k U[hYb'k]f'i bg'Ui Z'X]Y'Gi W.Y'b UW. 'DY Ubi h'i bX'F U]g]bž nk Y]''Y]XYf'b]W.h'U`g'k]`X'_`Ugg]Z]n]YfhY'; Yd UfXYb'''9]b'6Ui Yf hÒhYhY'X]Y'A i hhYf'XYf'; Yd UfXYb'i bX'VY\]Y`h'g]Yž'V]g'g]Y'Y]b'\$J\f U`h'k UfYb'''9f'f]YZ'5Zf]7 Uh'Ubž'U`g'Yf'XUg'; YZØ\`'\UhhYž'Yf'_ÒbbY'g]Yb]W.h'a Y\f'[fc»n]Y\Yb"

'U`h1 9]b'j Yfk U]ghYf'; YdUfX']a 'BUhi fgWli hn[YV]Yh C_cb']a U 25h`Ug'/ '6cchg'DYUbi hž'Y]b'j Yfk U]ghYf'; YdUfX']a BUhi fgWli hn[YV]Yh'C_cb']a U

5`g`k]f`Ub`X]YgYa `5VYbX`Y]bYb`a U^YghÀh]gW\Yb`GcbbYbi bhYf[Ub[ØVYf`XYa `5WUW]U`H\cfbj Y`X`VYcVUW\hYhYbžYbhgW\]YXYb`k]f`Y]b ZØf`U``Y`A U`.`BUa]V]U`]gh`Y]bYf`XYf`VYgcbXYfYb`CfhYž`X]Y`^YXYf`j cb i bg`^Y`[YgY\Yb`\Uh"

- 'U`h1 5Zf]7Uh'ZÒfXYfh'Y]bY'?i `hi f'XYg'Ni gUa a Yb`YVYbg']a BUhi fqWXi hn[YV]Yh'C cb'\a U 2
- 'U`h1 2

5h`Ug7 '6cchg

5i ZgdØfYb j cb @YcdUfXYb]a
B Uhi fgWli hn[YV]Yh C_cb]a U. XUg
K]Wlh][ghY

K Ug. '5i ZgdØfYb'j cb'@YcdUfXYb'i bX'; YdUfXYb']a B Uhi fgW\i hn[YV]Yh'C_cb']a U']b'BUa]V]U'U\g'HY]\'Y]bYf'\%+!h\\[][Yb GY\VghZU\fYf!GUZUf]'j cb'K]\'X'8c['GUZUf]g''

K c. '8]Y'I bhYfVf]b[i b['Ui Z'XYf'Hci f'i a ZUggh'%* 'BÀW\hY']b'Y]bYf FY]\Y'j cb'<chY`gž'@cX[Yg'i bX'GUZUf]!7Ua dgž'XUfi bhYf'XUg C_cb']a U'D`U]bg'7Ua d"

8]Y 'Hci f'_Ubb 'Ybhk YXYf'U`g'I bhYf_i bZh`fgc'k]Y 'k]f\z\z\z'7Ua d]b[cXYf'Y]bY'?ca V]bUh]cb'Ui g'VY]XYa '[YVi W\h'k YfXYb"': fØ\ghØW_i bX'a Y\fYfY'5VYbXYggYb'g]bX']b'XYf', VYfbUW\hi b[gcdh]cb Ybh\U`hYb/'7Ua d]b[']gh'k Y]h[Y\YbX'GY`Vghj Yfgcf[Yf"

K Ubb. 8]Y VYghY FY]gYnY]h ZØf B Ua]V]U]gh A U]! C_hcVYf k À\fYbX XYf Hfc W_YbnY]h fK]bhYft" 8]Y BYVYbgU]gcbYb A U] i bX Bcj Ya VYf g]bX [i h ZØf [Øbgh][YfY I bhYf_ØbZhY a]h \ Ò\YfYf J YfZØ[VUf_Y]h" =a Bcj Ya VYf _Ubb Yg ni ghUf_Yb FY[YbZÀ ``Yb _ca a Ybž k Ybb Ui WX `\Ui dhgÀWX `]WX]b _i fnYbž]bhYbg]j Yb 5i gVfØWX Yb"

K]Y. 'K]f'\UVYb'XUg'BUhi fgW\i hn[YV]Yh'C_cb']a U'i bX'5Zf]7Uh']a
FU\a Yb'i bgYfYf'GY`VghZU\fYf!GUZUf]'VYgi W\h''K]`X'8c['GUZUf]g
Vi W\h'I bhYf_ØbZhYž'ghY``h'Y]bYb'A]Yhk U[Yb'ni f'JYfZØ[i b['i bX
cf[Ub]g]Yfh'Y]bY'FY]gYfci hY'ZØf'X]Y'FY]gY'''6Y]'XYf'5b_i bZh']b
K]bX\cY_'k i fXYb'k]f'j cb'K]`X'8c['GUZUf]g'Ya dZUb[Ybž'X]Y'i bg
Y]bY'XYhU]``]YfhY'FY]gYfci hYž': U\fUbk Y]gi b[Ybž'?UfhYb'i bX

♣bZcfa Uh]cbYb'ni f'JYfZØ[i b['ghY``hYb"

K]f'g]bX'a]h'6f]h]g\'5]fk Umg'ØVYf' \approx \UbbYgVi f[']b'GØXUZf]_U'bUW\BUa]V]U'[YZc[Yb"'6i W\Yb'G]Y': `Ø[Y'ni 'XYb'VYghYb'DfY]gYb'ØVYfG_mg\UbbYf"

@cbY`m'D`UbYh'6chgk UbU'/ 'BUa]V]U']gh'Y]b'i a ZUggYbXYf FY]gYZØ\fYf'ZØf'BUa]V]U'i bX'Ybh\À`h'Y]b][Y'bØhn`]W\Y'H]ddg'ZØf Y]bYb'6Ygi W\']b'Gk U_cda i bX"

@Y]hV]`X.~5h`Ug~/~6cchg

8 Y hU]`q

6Ygi WXYb G]Y i bg Ui Z Y]bY!fY]gY "XY