

GYa VU`i b FY]gYZØ\fYf. * 'Yd]gW\Y 5_h]j]hÀhYb]b GYa VU`i bž BcfX!@ca Vc_

9]b'jc``ghÀbX][Yf'FY]gYZØ\fYf'ZØf'XYb'6YgiW\'jcb'GYaVU`ib @caVc_"'9bh\À`h'U_hiY``Y'\DZcfaUh]cbYb'ØVYf'X]Y'VYghYb 5_h]j]hÀhYb']b'X]YgYf'jYfgW\`UZYbYb'6Yf[fY[]cb']a'BcfXYb'jcb @caVc_"'

GYa VU`i b'J]``U[Y'@ca Vc_']gh'Y]bY'fi \][Y'6Yf[ghUXh']b'XYb
b`OfX`]W\Yb'6Yf[fY[]cbYb'XYf'\DgY`'@ca Vc_ž'\DXcbYg]Yb"'CVk c\`
b]W\h'j]Y`Y'Hci f]ghYb'GYa VU`i b'VYgi W\Ybž']gh'Yg
ØVYffUgW\YbXYfk Y]gY'Y]bYg'XYf'VYghYb'5VYbhYi Yfn]Y`Y']b
@ca Vc_"

Jcb'Yd]gWXYb'K UggYfZU``!A]gg]cbYb'V]g'\]b'ni 'i b[`Ui V`]WXYb HU[Ygk UbXYfi b[Ybž'\]Yf']gh'Y]bY'@]ghY'a]h'5_h]j]hÀhYb']b GYa VU`i bž'X]Y'G]Y'XUj cb'ØVYfnYi [Yb'k YfXYbž'X]Y'A UggYb'j cb?i hU'ni 'ØVYfqdf]b[Yb"

K]Y '_ca a h'a Ub 'bUWX 'GYa VU`i b'J]``U[Y @ca Vc_3

5 i Z'@ca Vc_'[]Vh'Yg'_Y]b'ÒZZYbh`]W\Yg'J Yf_Y\fggmghYa ž'XUg'bUW\GYa VU`i b'ZÀ\fh" \pm 0 Zc`[YXYggYb'a ØggYb'G]Y' \pm 1 fYb'Y][YbYb HfUbgdcfh'cf[Ub]g]YfYb'cXYf'gY`Vgh'\]Yf\Yf'ZU\fYb"

K Ybb'G]Y'j ca ': `i [\UZYb'UbfY]gYbž'Vi W\Yb'G]Y'Ua 'VYghYb'Y]bYb df]j UhYb'5i hchfUbgZYf'j ca ']bhYfbUh]cbU`Yb': `i [\UZYb'@ca Vc_'ZØfk Yb][Yf'U`g'' ('`"

9]bY'k Y]hYfY'VY`]YVhY'Cdh]cb'ZØf'X]Y'Yb][Ybž'X]Y'F]b'Ub]'k UbXYfb a ÒW hYbž']gh'X]Y'Cf[Ub]gUh]cb'⇒fYg'HfUbgdcfhg'a]h'⇒fYa FY]gYi bhYfbY\a Yb"'K Ybb'G]Y'j cb'GYbUfi 'Ui g'k UbXYfbž'gc``hY'Yg bi f'Yhk U'(\$'A]bi hYb'XUi Yfbž'V]g'G]Y'GYa VU`i b'YffY]WXYbž'k Ug b]WXh'a Y\f'U`g'%\$\$"\$\$F'dfc'5i hc'_cghYh"

'U'h1 A CHCFF58 B G9A 65@ B 8CF: '@CA 6C? 2

@9G9B'G=9'A 9<F', 69F'89B'F9GH'JCB'@CA 6C?' JC@GHŸB8 = 9F'@CA 6C?'F9=G9:, <F9F

9d]gWXY'8]b[Y'ni 'hi b']a '8cfZ'GYa VU`i b @ca Vc

@UggYb'G]Y'i bg'XUa]h'[`Y]W\'ni f'@]ghY'XYf'VYghYb'5_h]j]h\hYb']b GYa VU`i b'i bX'XYf'i a `]Y[YbXYb'FY[]cb'BcfX!@ca Vc_ ØVYf[Y\Yb"

%" DYf[Uq]b[Ub!< \emptyset [Y`k UbXYfi b[

 $\begin{tabular}{ll} K Ybb `Yg`_Y]bY`F]b `Ub]!; & [dZY`k UbXYfi b[`]ghž`]gh`X]Y`VY]`k Y]hYaVY`]YVhYghY`5_h]j]hAh`]b `GYa VU`i b `X]Y`K UbXYfi b[`Ui Z`XYb DYf[Ug]b[Ub! < \varnothing[Y`" \end{tabular}$

 $DYf[Ug]b[Ub'<]^{``'}gh'Y]b'[fc * Yf'<\emptyset[Y`ž'XYf'\emptysetVYf'XYb'FY]gZY`XhÀ`Yfb']cb'GYaVU`ib'`]Y[h''GY]b'\OWXghYf'Dib_h'`]Y[h'VY]'YhkU'%+) $$

A YhYfbž'k UgʻVYXYi hYhž'XUggʻG]YʻYhk Uʻ*\$\$'<Ò\Yba YhYf ØVYfk]bXYbʻk YfXYb"ʻ9gʻXUi Yfh'i b[YZÀ\f'%ž)ʻGhi bXYbž'i a ʻXYb ;]dZY`ni 'YffY]WXYbž'k cʻG]Yʻa]h'Y]b][YbʻXYfʻVYghYbʻ5i gg]WXhYb Ui Zʻ@ca Vc_'VY`c\bh'k YfXYb"

K Ybb'G]Y'g]WX'YbhgWXY]XYbž'XYb'DYf[Ug]b[Ub'<]```ni 'VYghY][Ybž k ØfXY']WX'Ya dZY\`Ybž'Y]bY'GcbbYbUi Z[Ub[gk UbXYfi b['ni a UWXYb'cXYf'U`hYfbUh]j 'Y]bYb'_ca V]b]YfhYb'HfY__]b[!'i bX 7Ua d]b[Ui gZi ['ni 'Vi WXYbž'i a 'Y]bY'BUWXh'Ui Z'XYa ';]dZY``ni j YfVf]b[Yb"

U`h1 8 F C < B 9 B 5 B G = 7 < H'J C A 'D 9 F; 5 G = B; 5 B ! < _; 9 @ G 9 A 6 5 @ B ž @ C A 6 C ? ! K 5 B 8 9 F I B; 2

@9G9B'G=9'A 9<F.'D9F; 5G=B; 5B!<,; 9@K 5B89FIB; 'C<B9: <F9F' 'G9A 65@ B'@CA 6C?

&"'A Ub[_i !GU_h]!K UggYfZU```fl5]f`HYf^i b A Ub[_i 'GU_h]Ł'

5i Z'XYf'Gi WXY'bUWX 'Y]bYa 'YWX hYb'K UggYfZU``!5VYbhYi Yf'UVgY]hg XYf'Ui g[YhfYhYbYb'DZUXY3'8Yf'K UggYfZU``'A Ub[_i 'GU_h]']gh'Y]bYf a Y]bYf'@]YV`]b[gZÀ``Y']b'@ca Vc_'i bX'Z`]Y» h'gY`Vgh']b'XYf HfcW_YbnY]h'ghUf_"

I a `\]Yf\Yf`ni `[Y`Ub[Ybž`XUiYfh`Yg`ib[YZÀ\f`&\$`A]bihYb`a]h XYa `AchcffUXž`V]g`G]Y`Y]bY`ibVYZYgh][hY`GhfU»Y`YffY]WXYb"`Jcb\]Yf`Uig`]gh`Yg`Y]b`'\$!a]bØh][Yg`CZZfcUX!5VYbhYiYf`ØVYf`Y]b][YibVYZYgh][hY`GhfU»Yb`XifWX`X]WXhYb`8gWXib[Y`ž`[YZc`[h'jcbY]bYa`%)!a]bØh][Yb`GdUn]Yf[Ub["

K Ybb'G]Y'_Y]b'Y][YbYg': U\ffUX'\UVYbž'_ObbYb'G]Y'hfchnXYa 'Y]bY Hci f'ni a 'A Ub[_i 'GU_h]'K UggYfZU``'Vi W\Ybž'X]Y'A]hhU[YggYb'i bX HfUbgdcfh'VY]b\U`hYh"'?`]W_Yb'G]Y'\]Yfž'i a 'XYb'U_hi U`]g]YfhYb DfY]g'ni 'ØVYfdfØZYb"

8 Yf'K UggYfZU```A Ub[_i 'GU_h]']gh'Y]b'[fc>Yf'&\$!A YhYf!K UggYfZU``
a]h'ghUf_'Z']Y>YbXYb'Ghfca gW\bY``Yb'Zi ggUVk Àfhg"'A Y]b
@]YV`]b[ghY]``Ub'X]YgYa 'K UggYfZU```]ghž'XUgg'G]Y'\]bY]b_`YhhYfb

i bX`XYb`a ÀW\h][Yb`:`i gg`\]bhYf`XYa `K UggYfZU```VYcVUW\hYb ÒbbYb°

U`h1 A 5B; ?I 'G5?H=K 5GG9F: 5@0+B '89F 'BŸ<9'JCB G9A 65@ Bž'@CA 6C?ž'G9A 65@ B '8CF: 2

J C @@GHŸ B 8 = 9F '6@C; . 'A 5B; ? I 'G5? H='K 5GG9F: 5@@Ž J C @@GHŸ B 8 = 9F '@9=H: 58 9B ' 'G9A 65@ B'

' "5i gg]WX hgdi b_h'6i _]h'GY`cb[F]WYZ]Y`X

GYa VU`i b'J]``U[Y'@ca Vc_'\Uh'gc[Uf'Y]b][Y'n]Ya `]W\'Yd]gW\Y 5i gg]W\hgdi b_hY'Ui Z'XYb'GcbbYbi bhYf[Ub['i bX'XYb GcbbYbUi Z[Ub["'9]bYg'XYf'VYghYbž'XUg'G]Y'Z]bXYb'k YfXYbž']gh 6i _]h'GY`cb[ž'XUg'g]W\'\]bhYf'Y]bYa ': `i gg'Ua 'FUbXY'XYg'8cfZYg VYZ]bXYh"

8]YgYf'YfZcfXYfh'_Y]bY '`Ub[Y'K UbXYfi b[ži a ']\b'ni 'YffY]W\Ybž VY`c\bh'G]Y'UVYf'XYbbcW\'a]h'Y]bYf'i b[`Ui V`]W\Yb'5i gg]W\h'Ui ZX]Y': `]W_YbhYdd]W\Y'XYf'GYa VU`i b!FY]gZY`XYf"'5i Z'XYf'UbXYfYbGY]hY'Yf\U`hYb'G]Y'Y]bYb'k Y]hYfYb'6`]W_'Ui Z'XUg'8cfZ'GYa VU`i bžkÀ\fYbX'G]Y'XYb'; YVYhYb'XYf'A cgW\YY'`Ui gW\Ybž'X]Y']b'XYf6Yf[`UbXgW\UZh'k]XYf\U``Yb"

±0 'X]YgYa 'HY]` 'XYg'8 cfZYg'g]bX'[fc» Y'GW\ÀXYb'YbhghUbXYbž'XU\YfjYf`Ub[Yb'X]Y'9][YbhØa Yf'XYg'; fibXghØW_g'Y]bYb'9]bhf]hhgdfY]gjcb') \$\$\$ 'Fid]U\ž'ia 'XYb'FY]gZY`X!5igg]W\hgdib_h'6i_]h'GY`cb[ni'VYgi W\Yb"'8]Yg'hfÀ[h'k YgYbh`]W\'XUni'VY]ž'XYf``c_U`Yb; YaY]bgW\UZh'VY]a 'K]YXYfUi ZVUi'bUW\'XYb'9fXVYVYb'ni'\Y`ZYb"U`h1 6I? #H'G9@CB; 'GH5B8DIB?H2

 $JC@GH\ddot{V}B8 = 9F^{\circ}:_{s} < F9F^{\circ}:_{s} < F9F^{\circ}:_{s} < G9A^{\circ}:_{s} < G9A^{\circ$

("5i gg]Wk hgdi b_h HUa Ub K]gUhU Di gi _

8 Yf'5i gg]W\hgdi b_h'HUa Ub'K]gUhU'Di gi _']gh'Y]b'k Y]hYfYf
i b[`Ui V`]W\Yf'6Yf[Ui gg]W\hgdi b_h'Ui Z'XYa ';]dZY`'XYg'GYa VU`i b"
=a '; Y[YbgUhn'ni a 'DYf[Ug]b[Ub'<]``'a ØggYb'G]Y'b]W\h'V]g'ni a

;]dZY``k UbXYfbž'XU`g]W\`XYf`5i gg]W\hgdi b_h`hUhgÀW\`]W\`Ua GhfU» YbfUbX`Ui Z'XYf`DUgg\O\Y`VYZ]bXYh"

 $8] Yg`]gh`Y]b`[fc*Ufh][Yf`5igg]W`hgdib_hž`ia`Y]bYb`kY]hYb`6`]W_UiZ`XUg`GYaVU`ib!HU``ibX`X]Y`aUgg]jYb`Ji`_Ub\Ø[Y``niYf\U`hYb"`G]Y`kYfXYb`UiW`X]Y`_`Y]bYb`DcfnY``Ub\AigYf`gY\YbZX]Y`ibhYf\U`V`XYg`DYf[Ug]b[\Ub!<<math>\emptyset[Y`g`ibX`XYg`F]b'Ub]!?fUhYfgfi\Yb"$

9g'[]Vh'Y]bY'_`Y]bY'6Ua Vi g!5i gg]Wkhgd`UhhZcfa ž'X]Y'g]Wk'ØVYf'XYbFUbX'YfghfYW_h'i bX'ZØf'Y]b][Y'Wcc`Yž'kYbb'Ui Wk'YhkUg'_]hgWk][Y:chcg'gcf[h"

U`h1 H5A 5B K €5H5 DI GI ? G=7 < HGDI B? H'G9A 65@ B @CA 6C? 2 H5A 5B K €5H5 DI GI ? 5I GG=7 < HGDI B? H' G9A 65@ B

I a '⇒bYb'ni '\Y`ZYbž'XYb'5i gg]Wkhgdi b_h'HUa Ub'K]gUhU'Di gi _'ni Z]bXYbž'\UVY']Wk']\b'i bhYb'Ui Z'XYf'; cc[`Y!?UfhY'Ub[Y\YZhYh" 5``YfX]b[g'_Ubb'a Ub'XUa]h'Y][Ybh`]Wk'b]Wkhg'ZU`gWk'a UWkYb" : c`[Yb'G]Y'Y]bZUWk'XYf'GhfU»Y'XYb'[UbnYb'K Y['X]Y'6Yf[ghfU»Y\]bUi Zž'V]g'G]Y'XYb';]dZY``YffY]WkYbž'k c'G]Y'XYb'5i gg]Wkhgdi b_h HUa Ub'K]gUhU'Di gi _'Z]bXYb"

5i Z'XYf'Gi W\Y'bUW\'k Y]hYfYb'5VYbhYi Yfb'UVgY]hg'XYf Ui g[YhfYhYbYb'DZUXY']b'@ca Vc_3'B]W\h'j YfdUggYb.'8]Y') 'VYghYb 5_h]j]hÀhYb']b'GY_chcb['@CA6C?"

) " 6 Y f [! F] b 'U b]! H f Y _ _] b [

8 Yf '6 Yf['F]b 'Ub] ']gh'XYf'\ ÒW ghY 'Di b_h'Ui Z'@ca Vc_'i bX'XYf nk Y]h\ ÒW ghY 'J i `_Ub '\D XcbYg]Ybg 'F]b 'Ub]!HfY__]b[']gh'XYf'; fi bXž k Ufi a 'j]Y 'Y '@Yi hY 'B cfX!@ca Vc_'VYgi W Ybž'i bX']W 'a UW Y']\ bYb _Y]bYb 'J cfk i fZ' 'HfY__]b['i bX '7 Ua d]b['Ua 'F UbX'XYg'? fUhYfg'k Uf Y]bYg'a Y]bYf'@]YV ']b[gYf'YVb]ggY']b '@ca Vc_"
U`h1 A CI BH'F \B \S B \D ?F 5 H9F F 5 B 8 'I B 8 '5 B 5? 'G99 2
K i gghYb 'G]Yž'XUgg'U``Y 'F]b 'Ub]!;]dZY `k UbXYfi b[Yb'j cb'GYa VU`i b Ui g'ghUfhYb3'C Vk c\``XUg';]dZY`hfY__]b['[fÒ> hYbhY]`g'[YgW `cggYb]ghž']gh'Yg'XYbbcW 'a Ò[`]W ž'Y]bY'F]b 'Ub]!? fUhYffUbXk UbXYfi b[j cb'GYa VU`i b'Ui g'ni 'UffUb[]YfYb"

6YUa hY'VYk YfhYb'XYfnY]h'X]Y';]dZY'dZUXY'XYg'A ci bh'F]b'Ub]'bYi i bX'VUi Yb'g]Y'k]YXYf'Ui Z''8 Ug'VYXYi hYhž'XUgg']b'? ØfnY [fc» Ub[Y'Y[hY';]dZY'YI dYX]h]cbYb']b'j c''Ya'; Ub[Y'gY]b'gc''hYb'' 9]b'k Y]hYfYf'; fi bXž'XUg'GYa VU'i b'J]''U[Y'@ca Vc_'ni 'VYgi WXYb'' U'h1 JI @ 5B'69F; 'F \Rightarrow 5B = 2

F = B > 5 B = ; I = 8 9. A C I B H F = B > 5 B = 7 F 5 H 9 F F = A ' < = 9 ' & \$ % - ` ' 5 @ @ 9 G ž K 5 G ' G = 9 ' K = \$ G 9 B ' A , G G 9 B

* "'F Y]hYb 'G]Y 'Xi fWX 'X]Y '9fXVYYfZY `XYf'

9]bY'k Y]hYfY'i bYfk UfhYhY'GUW\Y']b'GYa VU`i b'k Uf'Ygž'X]Y
9fXVYYfZY`XYf'ni 'Yf_i bXYb"'K Ybb'G]Y'Y]b'A chcffUX'i bX'Y]b
k Yb]['NY]h'\UVYbž'_ÒbbYb'G]Y'X]YgY`VY'GhfU» Y'bY\a Ybž'X]Y
Xi fW\'Y]b][Y'gdY_hU_i `ÀfY'9fXVYYfZUfa Yb'ni a '5i gg]W\hgdi b_h
HUa Ub'K]gUhU'Di gi _'ZØ\fh'

G]Y 'k YfXYb 'ZYghghY ``Ybž'XUgg'8 cfZVYk c\bYf']\fY 'Zf]gW\ Ub[YVUi hYb'6Yf[YfXVYYfYb'Ua 'GhfU» YbfUbX'j Yf_Ui ZYb"'J]Y`Y Yf`Ui VYb' \Rightarrow bYb'Ui W\ž'Zf]gW\Y'9fXVYYfYb'Ui Z']\fYf': Ufa 'ZØf'bi f Y]bY'GdYbXY'j cb'&\$'\$\$\$Fi d]U\'ni 'dZØW_Yb° U`h1 G9A 65@ B'8CF: '@CA 6C?'9F8699F: 9@89F 2

5i ZYbh\U`h']a 'GYa VU`i b'J]``U[Y'@ca Vc_' I bhYf_i bZhgZØ\fYf

I bhYf_ØbZhY`]b`GYa VU`i b

I BH9F?I B: H: B: A 9 B 9A G9A 65@ B. FUX]mU\; i Ygh\ci gY:8]Yg
]ghY]bY:XYf'dfY]g[Øbgh][ghYb:I bhYf_i bZhga Ò[`]WX_Y]hYb:]b
GYa VU`i b"'=\W 'k ØfXY:g]Y:XYZ]b]h]j 'k Y]hYfYa dZY\`Yb":8]Y:N]a a Yf
g]bX:_`Y]bž:UVYf'gY\f'gUi VYf'i bX:\UVYb:U``Yg'k Ug'a Ub'VfUi WXh"
9g:[]Vh'i bVY[fYbnh:_cghYb`cgYb'?UZZYY'i bX:HYY'gck]Y:Y]b
cghYb`cgYg': fØ\ghØW"'8Yf'9][YbhØa Yf']gh'Ài »Yfgh'\]`ZgVYfY]h

i bX cf[Ub]g]Yfh ZØf G]Y Y]b A chcffUX ZØf) \$"\$\$\$ =8 F dfc HU["Uh1 ; YGH9 < 51 G F 58 =46 < =8 @C A 6C? =8 CB 9G =9B 2 69GH9 IB H9F? IB: H =4 =8 B!GH =6 GYa VU ib ?]hU 7 chhU[Y 8]Yg]gh k U\fgWX Y]b]WX XYf Cfh z XYb]WX [YVi WXh \AhhY z k Ybb]WX b]WX h]a FUX]mU\ ØVYfbUWXhYh \AhhY "G]Y \UVYb hc `Y ?f]h]_Yb z dfY]g[Øbgh][Y N]a a Yf ib X [fc > Y 6YhhYb "9g VY]b \U`hYhY Y]b _cghYb`cgYg : fØ\ghØW_z XUg Ui Z 6cc_]b["Wca 'U`g 'gY\f [ih Y]b[Yghi Zh k]fX"

'U'h1 G9A 65@ B'? \ H5'<, HH9' \ @CA 6C?' \ B8CB9G \ 9B 2

$Ni X]f \setminus b \emptyset V Y f$

8 Ua]h'YbXYh'X]YgYf'GYa VU`i b!FY]gYZØ\fYf"'K Ybb'=\bYb'X]YgY @]ghY'XYf'VYghYb'5_h]j]hÀhYb']b'GYa VU`i b'[YZU``Yb'\Uhž'`YgYb'G]Y i bVYX]b[h'a Y]bY'UbXYfYb'5fh]_Y`ž'X]Y'U``Y'UbXYfYb'VY`]YVhYb FY[]cbYb']b'@ca Vc_'UVXYW_Yb"

<Ugh'Xi 'bcWX 'UbXYfY 'Yd]gWXY '5VYbhYi Yfž'X]Y ']WX 'Ui Z'a Y]bYf
FY]gY 'bUWX 'GYa VU'i b'j YfdUggh'\UVY3'@UggYb'G]Y'Yg'a]WX 'i bhYb
k]ggYb°</pre>

U`h1 H5A 5B K =G5H5 DI GI ? G==7 < HGDI B? H'G9A 65 @ B @CA 6C? 2

U`h1 2

U`h1 2

U`h1 8FC<B9B5BG=7<H'JCA'D9F; 5G=B; 5B!<,; 9@'G9B5FIž @CA6C?!K5B89FIB; 2

U`h1 G9B5Fl!F9€: 9@89F'lB8'D9F; 5G₺; 5B!<¸; 9@ž @CA6C? 2

U`h1 8FC<B9B5BG=7<H'JCA'D9F; 5G=B; 5B!<,; 9@'G9A6I@5Bž @CA6C?!K5B89FIB; 2

'U`h1 *'9D\f37<9'8\f3; 9'\f3'G9A65@B''BCF8!@CA6C?

П

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