

5HJ 1R

&RGH 1R

1DPH

6HFRQG <HDU ±

0DUFK

7LPH +RXUV  
&RRO RII WLPH 0

3DUW ± ,,,

&+(0,675<

0D[LPXP 6FRUHV

\*HQHUDO ,QVWUXFWLRQV WR &DQGLGDWHV  
 x 7KHUH LV D μ&RRO RII WLPH¶ RI PLQXWHV LQ DGGLV  
 x 8VH WKH μ&RRO RII WLPH¶ WR JHW IDPLOLDU ZLWK T  
 x 5HDG TXHVWLRQV FDUHIXOO\ EHIRUH DQVZHULQJ  
 x 5HDG WKH LQVWUXFWLRQV FDUHIXOO\  
 x &DOFXODWLRQV ILJXUHV DQG JUDSKV VKRXOG EH VI  
 x 0DOD\DODP YHUVLRQ RI WKH TXHVWLRQV LV DOVR SU  
 x \*LYH HTXDWLRQV ZKHUHYHU QHFHVVDU\  
 x (OHFWURQLF GHYLFHV H[FHSW QRQ SURJUDPPDEOH F  
 ([DPLQDWLRQ +DOO

39%e8¿•9 Áh;• >(8#;'9¿?f4jÁ

x '9¿f9Š 6,-q9'D (;/9,'9,D <Á> 8)D o8-9.9h; í  
 x <Á 8)D >> ? 8%ejÁ (.9 ->t 8'; q.jÁ 6<f#"  
 > w8'; (?-8 9h; í  
 x q.jÁ 2;#;s#9'D;uD 8%ejÁ —"8(<¿x 38-9h" í  
 x '9¿?f4jÁ ;;2;3'; —"8(<¿x 38-9h" í  
 x "hD <n0; Áì 9f#jÁì f 8); Áì s93 q.?(t/9Á #>s  
 o8-9.9h" í  
 x ? 8%ejÁ ,0-81q90; '°9-9n;oD  
 x 34e,;••0qD 6,38 ejÁ > 8 ;h" í  
 x ?f(8f 8,; Á > w8'8 8q 8Àh;?0,/; Á 29> -;• .;  
 0 D?f 8"9 D (."3; (:d87819À (?-8 9h;38¾ (8 9yí

4XHVWLRQV WR &DUU\ RQH VFRUH HDFK \$QVZHU

:KDW LV WKH FR RUGLQDWLRQ QXPEHU RI SDUWLFOHV

,GHQWLI\ WKH RUGHU RI UHDFWLRQ\ LI WKH XQLW RI UD

:KDW LV WKH VWUXFWXUH"RI FKURPDWH LRQ &U2

1DPH WKH WHVW XVHG WR LGHQWLY\ HWK\ DQ\ DPLQHV

:KLFK DPRQJ WKH JLYHQ YLWDPLQV LV ZDWHU VROXEO

- D \$
- E %
- F '
- G (

:KDW LV WKH FURVVOLQNHG SRO\PHU REWDLQHG EA  
IRUPDOGHK\GH "

BBBBBBBBBB LV DQ DUWLILFLDO VZHHWQHU ZKLFK LV X

4XHVWLRQV WR \$QVZHU DQ\ WHQ (DFK TXHVWLRQ  
6FRUHV

D %DVHG RQ WKH QDWXUH RI LQWHUPROHFXODU IRU

L 6L2

LL ,FH

6FRUH

E =Q2 WXUQV \HOORZ RQ KHDWLQJ :K\ " 6FRUH

\$ VROXWLRQ FRQWDLQV J=XUSHU DRODUH RDWROXWL  
KDV WKH VDPH RVPRWF SUHVXUH DV D VROXWLRQ RI  
ZDWHU &DOFXODWH WKH PDVV RI JOXFRVH6FRUHVHW L

'HILQH PLQLPXP ERLQLQJ DJHRWURSHV ZLW6FRUHVSOH

,;#À± 3>. ? 8%ejÁhD 8?.8s9'; 8?.8 ?ÿ8¿ 3:# í  
? 8%ejÁh; q.>,2;#; í ?ÿ8¿6Du

)&& 9¥0:- '-;> 9•8' j1;> ? 8¿ 9?'5¼ 6 e  
f# "

?/,D •9.8iq9>¤ -<P R,ED# - .; .86f(3¿q'q9>¤ 8¿ ¿  
#9.9k/9-; í

?f 8?,,D-8"9>¤ &U2 ' rD "

&+& -; q?'8Á ? ¿q.2+ (?-8 9kD>f(/9 ,:'; >1  
#9.9k/9-;s (.:d"q9>¤ ?(.D 2;#; í

#s9.9h;s >>3,,9'; 19À 0q9À 0-9#D's#D

D \$  
E %  
F '  
G (

)9?'81; ì ?)8¿,8À 9>>7 ; ?(819>, >>/?65¼ ' q9-8À 0+  
(.6, \*Ž9# ?(819,¿" #D

(8 > w83;s B59À •9.#-9y8q ,&;. '°;s =f#9,  
.863±;38"DBBBBBBBBBB

,;#À± 3>. ? 8%ej19À 8?.8s9?;ÿ8.pD3:# í >#i90;  
(>qq9'; q.>,2;#; í ?ÿ8¿6Du

D#™8f# 1;> (.6\*Ž'q9>¤ 6g+83q9>¤ 9•8'q9À  
#8>2 > 8 ;q9.9h;s .3±;hÁ #. #9.9h; í

L 6L2

LL ,FH

E < 8h9-8ÀQ2m'9/,8 ;s;í r; > 8oD

?ÿ8¿

?ÿ8¿

J</9- è?,819h;18¿ ,86DRO; 09,¿ 0q9À 0-9t9k

08-'9h; ì {<?h86D è?,819h;18¿ jP,80D0:- 08-'9h;

? . 8?819 D¿f,8";•#Dí i9À {<?h869>¤ .; 09,¿ 0

08-'9-9À j9-9.9h;s {<?h869>¤ 13D "h8hÿ8¿6D

,9'9, ?\*8-9096D?-8?f 8t; Á >rsD %87." 679#

'9¿x 9h; í

?ÿ8¿6D

:ULWH WKH FKHPLFDO HTXDWLRQ RI WKH IROORZLQJ U  
 D 3UHSDUDWLRQ ;HI) ;H2 6FRUH  
 E 0L[LQDQW);H 6FRUH

([SODLQ KRZ WKH FRPSOHVDO Q1@NEDYH> GLIHHUHL  
 VWUXFWXUHV EXW GR QRW GLIIHU LQ WKHLUFRPHQHWL

&RPSOHWH WKH UHDFWLRQ  
 D &+%U\$J&1 BBBBBBBBBB 6FRUH  
 E &+%U...1o BBBBBBBBBB 6FRUH  
 'U\HWKHU

'XULQEHOKPLQDWLRQ UHDFWLRQ RI EURPRSHQWDQH  
 UHVXOWV 3HQW HQH DV PDMRU SURGXFW DQG 3HQW  
 H[SODLQ WKH UHDFWLRQ 6FRUHV

\$URPDWLF DOGHK\GHV XQGHUJR HOHFWURSKLOLF VXI  
 UHDFWLRQ RI EHQ]DOGHK\GH ZLWK FKHPLFDOHTXDWLRQ

%ULHIO\ GHVFULEH \*DWWHUPDQ .RFK UHDFWLRQIV

+RZ FDQ LW FRQYHUW PHWK\O LRGLGH WRFRKIDQDPLG

6WDWH WZR GLIIHUHQFHV EHWZHHQ JOREXODUHQG IL

0DWFK WKH IROORZLQJ

D	3RO\DFU\ORQLWULO	L	7HU\OHQH
E	%XWDGLHQ \$FU\ORQLWULO	LL	1DWX
F	(WK\OHQH JO\FRO	7HUH	SKWKDOLF DFLG LLL %
G	FLV SRO\LVRSUHQH	LY	6\$FRULHVDQ

D :KDW DUH GUXJV " 6FRUH  
 E :ULWH DQ H[DPSOH IRU D GUXJ FODVVLEHGHEDVHG

#8>2 > 8 ;q9.9h;s .86 f(3¿q'j1;> .86 6,38 e 2;#; í  
 D ;Á)'9s;;H2-;> '9¿v8" í ?ÿ8¿  
 E 3W);H 0¿q;s;í ?ÿ8¿

'9h09>¤ 6 -;^j18- >1L &@ >1L &@ 3e#e±  
 '18>"i90; 8r9 6g+83q9À 3e#e86 394%#D.9h; í  
 '9hÀi ?,8,9 'D¿ ?ÿ8¿6D

.86 f(3¿q' (<¿q: .9h;  
 D &+%U\$J&1 BBBB BBBB ?ÿ8¿  
 E &+%U...1o BBBB BBBB ?ÿ8¿  
 'U\ HWKHU

EURPRSHQW D QHÀ h?7+19 08-'9-; ,8-9 ? ¿ qD s  
 E 09,9?'5¾ f(3¿q' , 30 QW f(8QH \$,8-; i3HQW HQH  
 f(&8' \$,8-; 0+9h;s;í E f(3¿q' 394%: .9h;s '9-,  
 f(±839h; ?ÿ8¿6D

? .8,8,9 D À 9>>7 ; Á ?0 0)909 D ¥96,8D 5¾  
 f(3¿q'jÁ 8"9h;s;í >\*¾68À 9>>7 9>¤ >>'?f 5¾  
 .86f(3¿q' .86 6,38 e,8-9 2;#; í ?ÿ8¿6D

n¿,8¾ 8kD86f(3¿q' ;.;h9 394%: .9h; í ?ÿ8¿6D

,:>>#¾ ?-8>> qD8>>,¾ h9 ,8,;s>#j>" ?ÿ8¿6D

{8\*;08¿ ?f(8n:'; 1; >2f(8'6D; 1; #v90;• .oD 3e#e86jÁ  
 2;#; í ?ÿ8¿6D

? .; ( 9 ? ¿ h;

D	3RO\DFU\ORQLWULO H	L	7HU\OHQH
E	%XWDGLHQ \$FU\ORQLWULO H	LL	1DWX
F	(WK\OHQH JO\FRO	7HUHSKWKDOLF	DFLG LLL %
G	FLV SRO\LVR S	UHQH	LY \$FULODQ

?ÿ8¿6D

D,.;s; Á s8À rD' ?ÿ8¿  
 E .86 '-;> 9•8'q9À #. #9.9k ,.;s; ÁhD .; %87."  
 2;#; í ?ÿ8¿

4XHVWLRQV WR \$QVZHU DQ\ VHYHQ (DFK TXHV  
6FRUHV

\$Q HOHPHQW FU\VWDOOLVHV DW\ &XZLWFKHGQKDLWLQJ  
î ± FP &DOFXODWH WKH PRODU\$PDVV Rii WRH HOHPHQW

6FRUHV

:ULWH WKH DQRGH DQG FDWKRGH UHDFWLRQV RFFXU  
OHQWLRQ WKH HOHFWURO\WH XVHG LQ WKH6FRUHV\

)RU K\GURO\VLV RI PHWK\O DFHWDWH LQ DTXHRXV  
REXHUYHG

W V			
&+&22&+			
& PRD /			

6KRZ WKDW LW IROORZV SVHXGR ILUVW RUGHU UHDFW  
FRQVWDQW 6FRUHV

D 6WDWH +DUG\ 6FKXOJH UXOH ZLWK WKHFRUHV RI F  
E :K\ O\RSKLOLF FROORLGV DUH XVHG DV6FRUHV\

\*LEEV HQHUJ\ RI IRUPDWLRQ&Z . DQG . DUH JL  
EHORZ

'<sub>1</sub>\* >0J2@ ± N-DVRO .

'<sub>1</sub>\* >&2@ ± N-DVRO .

'<sub>1</sub>\* >0J2@ ± N-DVRO .

'<sub>1</sub>\* >&2@ ± N-DVRO .

2Q WKH EDVLV RI WKH DERYH GDWD SUHGLFW WKH WH  
UHGXFLQJ DJHQW IRU 0J2 6FRUHV

,;#À 3>. ? 8%ej19À >2pq9'D q.>,2;#; í 8?.8s9';  
,<sD ÿ8¿í ?ÿ8¿6Du

.; ,<0 )&&-8-9 f 9¥0: .9h>tn?t8Á #9>¤ 68fJ#FP  
-9 f 9¥09À -<">96D9>¤ f ':1 î ± FPI9À ,<0 q9>¤  
?,818¿ ,8'0Bh; \$1 î PRO ?ÿ8¿6D

>0 D ?¥8?/ D8,/9-9>0 ?'8 9>0-; 8?\$8 9>0-; .86  
f(3¿q'jÁ 2;#; í \*8,/9-9À (?-8 9h;s?f08D>0>#sD  
2;#; í ?ÿ8¿6D

,:>>#À 69?,,9>¤ 0:- 08-'9>- >>7?f 09-9t8ÁD0+9k  
'9.:d"jÁ ;3> ? ¿q9.9h;s;í

W V			
&+&22&+			
& PRD /			

0q9>¤ 8!# •9. 6 e-8-9 #; .;s;>3iÁ E f(3¿q' .;  
6e<? 8 )¥D 8¿ ¿ f(3¿q',8>>#1D-9h; í ?ÿ8¿6D

D78¿ 95e<À6D '9-, %87." 679# f(±839hÿ8¿6D  
E 0?-8)909>D8?18-9 ; Á r;> 8o8f(D8>n©:3D18-9 ;  
18-9 (?-8 >t ;q;s#D ?ÿ8¿

.E58390; . E583900Ji2v>¤-; &2j>¤-; 9\*DfD

'¿ 9 8)D ?)8¿ ?;5³/4#8>2 > 8 ;h;s;

' | \* >0J2@ ± N-DPR O .

' | \* >&¿@ ± N-DPR O .

' | \* >0J2@ ± N-DPR O .

' | \* >&¿@ ± N-DPR O .

,; 19À 6< 9t9k 390 1;> 9•8'q9À 83#9D8 15 2v>¤

'9?.8: 8.9-8-9 8¿ \*½ (?-8 9h>ít ;s#D ?ÿ8¿6D

D :KDW LV WKH IRUPXOD RI SKRVSKLQH "6FRUH  
E +RZ SKRVSKLQH LV SUHSDUHG LQ ODERFUERUW\ "

\$VVLJQ WKH SRVVLEOH UHDVRQ IRU WKH IROORZLQJ  
D 6WDELOLW\ RI R[LGDWLRQ VWDWH GHFUHDVHV  
GRZQ WKURXS HOHPHQWV 6FRUH  
E 2+LV OHVV DBLGLF WKDQ + 6FRUH  
F 3+2 DFW DV D JRRG UHG32FGJH DJHQW ZK6DRUH

\*LYH UHDVRQV IRU WKH IROORZLQJ  
D 7UDQVLWLRQ PHWDOV DQG PDQ\ RI WKH6EUFHPSRX  
E 6FDQGLXP = GRHV QRW H[KLELW YDULDEOH F  
DV D WUDQVLWLRQ HOHPHQW 6FRUH  
F :ULWH WKH VWHS LQYR&UHGURP WKURSPHSDUWLR

+RZ ZRXOG \RX DFFRXQW IRU WKH IROORZLQJ  
D \$OGHK\GHV DUH PRUH UHDFWLYH WKDQ NHWRQ  
UHDFWLRQ 6FRUH  
E %RLOLQJ SRLQW RI DOGHK\GHV DUH ORZFRUWKDQ  
F \$GGLWLRQ UHDFWLRQ RI VRGLXP K\GURJHQ VXO  
SXULILFDWLRQ RI DOGHK\GHV 6FRUH

4XHVWLRQV WR \$QVZHU DQ\ WКУНН (DFK TXHV  
6FRUHV

D :KDW DUH SULPDU\ EDWWHULHV " 6FRUH  
E 7KH FHOO SRWHQWLDO RI D PHUFXU\ FHOO LV  
\*LYH UHDVRQ 6FRUH  
F :ULWH WKH HTXDWLRQV RI WKH UHDFWLRQV LQYR  
FHOO 6FRUHV



D?)86D>>)>α .8638 e" rD ?ÿ8¿  
E (.:d"480-9À ?)86D)¼ '9¿v9h;s>#j>' ?ÿ8¿6D

#8>2 > 8 ;q9.9h;s3-;> 8." 6< 9t9h;  
D 8 f <t; ,<0 j19À f <t9'; ,; 19À '9s; #8?2h; 3.;?r  
8 »."83•-;> •9.# ;/-; -; -;> •9.# < ; -;  
> w;s;í ?ÿ8¿  
E 6>'h81; ~ 6g+83 ;/m 6 -;^+8"D ?ÿ8¿  
F 3+2 .; 'y '9? .:88»9-8í" Ds8À+ 32 '9?.8: 8.9 y  
?ÿ8¿

8." 8"9h;  
D 6 f , " ?087j1; 3-;> 90 6 -;^j1; À?f(. j18"D  
?ÿ8¿  
E ÿ8α9- = 3e#e± 8.»83• 8"9h8#9.;s9n; .;  
6 f , " ,<0 ,8-9 "h8h;s; ?ÿ8¿  
F ?f 8>>.,D -9.9À D8829¿v9h;s 39& 2;#;?ÿ8¿

#8>2 > 8 ;q9.9h;s3>- j>' 390-9.;q8  
D 'e<z9?-8)909 D 95¼ f(3¿q'j19Ài À 9>>7 ; Ái  
:?,8"; >1h8Á f(3¿q' ,9 3; 8"9h;s; ?ÿ8¿  
E Àh?781; >1h81; #91'90 ;/À88">D>7 ; ÁhD  
?ÿ8¿  
F ?68 9- >>7f ¼ 6Á>>),,;8-;• :5¼ f(3¿q' À 9  
>>7 ; 1;> ?3¿#9.9h09'; 4;" : ."q9'; (?-8ÿ8h;s;í

,;#À 3>.-;• ? 8%ej19À >#i90; ,<>spq.9'D;#; í  
8?.8s9'; '80; ?ÿ8¿í ?ÿ8¿6Du

D>>f(,/9 \*8,/9 Á s8À" rD ?ÿ8¿  
E .; >,¿h;/9 >6y9>α >6À >(8n¼ 5#À>α 368'  
3>. #; ¿k-8-9 0+9h;s;í 8." 394%: .9h; ?ÿ8¿  
F ± 2)e<3À >6y9>0 8?.8f 80;D190;,,;• .86 6,38 e  
2;#; í ?ÿ8¿6D

D 'UDZ WKH VWUXFWXUHV RI J&R@HWULFDORUMRPHU  
E :ULWH WKH IRUPXOD RI SHQWDDPPLQHFDUREHQDWR  
F :ULWH DQ\ WZR OLPLWDWLRQV RI YDODQFFRUERQG V

D \*ULJQDUG UH DJHQWV DUH LPSRUWDQW FODVV R  
SUHSDUH DOFRKROV ,GHQWLI\ WKH FRPSRXQGV \$ DO

L +&+20J&+U...U\ HWKHU \$ 0J 2+ %U  
-2

LL %0J&+U...U\ HWKHU &+± &±2+ 0J 2+ %U 6FRUHV  
-2  
-+&

E :ULWH WKH QDPH RI SURGXFWV IRUPHG ZKHQ VD  
DQK\GULGH LQ DFLG PHGLXP 6FRUHV

/XFDV WHVW LV XVHG WR LGHQWLI\ SULPDU\ VHFRQGD

D ([SODLQ WKH SURFHVV

E 1DPH WKH UH DJHQWV XVHG LQ WKH WHVWUHV

BBBBBBBBBBBB

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D >)H &#1@ #.;s 9?-8>,f 9hÀ > ?68>, /; 1;> ' 3.-; í ?ÿ8¿6D  
E .8638 e 2;#; í 3HQWDDPPLQHF DUERQDWRFR EDOW ,,, ?ÿ8¿RULGH  
F 380¾6D\*8oD 69"8rq9>¤ .oD ?(828#; í ?ÿ8¿

D Àh?781; 1;> '9¿v8"q9À (?-8 9h;s f(&8' .863±; h18"D f 9 D/'8¿- D; \$í %s93 #9.9k/9mD .8638 e 2;#; í

L +&+2 0J&+U...U\ HWKHU \$ 0J 2+ %U

LL %0J&+U...U\ HWKHU &± &±2+ 0J 2+ %U ?ÿ8¿6D  
&+

E 680969096D D 6,9 D½>>7>>f 9>¤ ~08-'9-; ,8-9 ? ¿s8À 0+9h;ssq0,>¤ ?(>.2;#; í ?ÿ8¿6D

>>f(,/9ì >6h¤/9ì ? ¿5e/9 Àh?781; >1 #9.9k/9-;s#9';( h;s .; (:d",8"D0<h86D (:d" í

D (:d" 393.9h; í E (:d"q9À (?-8 9h;s .863±;h1;> ?(>.2;#; ?ÿ8¿6D

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