TPG 4145 Quiz 2 (held Nov. 21, 2013)

M=5: solve for \underline{all} values in blue empty boxes.

	T . D D D (D .)	0.5		(17)
	Test Reservoir Rate Constant (Darcy)	CR CT		scf/D/psia^2
	Test Tubing Rate Constant	CI	25000	scf/D/psia
	Initial Gas In Place	G	1.00E+12	scf
	Permeability	k		md
	Net Thickness	h	164	
	Skin	s	8.7	(slightly changed from class value)
	Reservoir Temperature	TR	150	oF
	Initial Reservoir Pressure	pRi	2000	psia
	Irreducible (connate) water saturation	Swi	0.2	fraction
	Aquifer volume ratio	M	5	I-
	Water compressibility	CW	3.50E-06	
	Formation rock (pore) compressibility	cf	7.00E-06	
	Gas specific gravity	γg		air=1
	Low-pressure gas viscosity	ug 7-	0.0143	ср
	Low-pressure Z-factor	Zg	1	
	Test tubing inner diameter	dT	3.5	in
	True vertical depth top reservoir	TVD	5000	
	Static gas column average temperature	Tavg	130	
	Static gas column average Z-factor	Zgavg	0.94	
	Grand gard contains an orange _ narray	-99		
	Minimum flowing tubing pressure	ptmin	500	psia
	%IGIP sold per year	∆(Gp/G)	0.055	fraction
	Plateau period	tplateau	10	years
	Drainage area radius ratio term	In(re/rw)-0.75	8	
1	Daily Field Rate	qgF		scf/D
	•	10		
2	Static gas column constant	S		-
	Static gas column constant	exp(S)		convert bottomhole p ² to surface p ²
	Static gas column constant	exp(S/2)		convert bottomhole p to surface p
•	OD from a working 4/Auch (Fr. 40)	OD		1.A
3	CR from equation = 1/Awh (Eq. 19) (in terms of pc and pw)	CR		Mscf/D/psia^2 scf/D/psia^2
	(iii terms or pc and pw)			SCI/D/psia·2
	Assume Material Balance ignoring Zg (set Zg=	=1 at all pressure	es),	
	but including "ce" term; solve as quadratic equation for pR.			
	Title of the control			14 /:
4	Effective cumulative compressibility	ce		1/psi
5	Average reservoir pressure at end plateau	pR		psia
6	· ·	рс		psia
	Unmodified (Test) Well			•
7	Well qg with ptmin at end plateau	qg		scf/D
8	Number of wells required at end plateau	Nw		
9	Modify dT=6 inches (inner diameter)	СТ		scf/D/psia
10	Well gg with ptmin at end plateau			scf/D
11	Number of wells required at end plateau	qg Nw		36//10
••	realise of wells required at one plateau	1444		ı
12	Modify s=-4	CR		scf/D/psia^2
13	Well gg with ptmin at end plateau	qg		scf/D
14	Number of wells required at end plateau	Nw		
				- 1
15	Modify s=-4	CR		scf/D/psia^2
16 17	Modify dT=6 inches (inner diameter)	CT		scf/D/psia
17	Well gg with ptmin at end plateau	qg Nu		scf/D
18 10	Number of wells required at end plateau % (pc-pt) in reservoir at end plateau	Nw (nc-nw)/(nc-nt)		0/_
19 20	% (pc-pt) in <u>reservoir</u> at end plateau % (pc-pt) in <u>tubing</u> at end plateau	(pc-pw)/(pc-pt)		% %
20	70 (po-pt) iii <u>tubiiig</u> at ellu plateau	(pw-pt)/(pc-pt)		70

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Below you find a solved solution to the Quiz for M=10. You may find it useful in helping you solve for M=5.

	Test Reservoir Rate Constant (Darcy) Test Tubing Rate Constant	CR CT	20 scf/D/psia^2 25000 scf/D/psia
	Initial Gas In Place Permeability	G k	1.00E+12 scf 20 md
	Net Thickness Skin	h	164 ft 8.7 (slightly changed from class value)
	Reservoir Temperature	s TR	150 oF
	Initial Reservoir Pressure	pRi	2000 psia
	Irreducible (connate) water saturation Aquifer volume ratio	Swi M	0.2 fraction 10 -
	Water compressibility	cw	3.50E-06 1/psi
	Formation rock (pore) compressibility	cf	7.00E-06 1/psi
	Gas specific gravity Low-pressure gas viscosity	γg	0.70 air=1 0.0143 cp
	Low-pressure Z-factor	ug Zg	1
	Test tubing inner diameter	dT	3.5 in
	True vertical depth top reservoir	TVD	5000 ft
	Static gas column average temperature Static gas column average Z-factor	Tavg Zgavg	130 oF 0.94 -
	Static gas coldinii average 2-ractor	zgavg	0.54 -
	Minimum flowing tubing pressure	ptmin	500 psia
	%IGIP sold per year Plateau period	∆(Gp/G) tplateau	0.055 fraction 10 years
	riateau periou	ipiateau	To years
	Drainage area radius ratio term	In(re/rw)-0.75	8
1	Daily Field Rate	qgF	1.51E+08 scf/D
2	Static gas column constant	S	0.237
	Static gas column constant	exp(S)	1.267 convert bottomhole p² to surface p²
	Static gas column constant	exp(S/2)	1.126 convert bottomhole p to surface p
3	CR from equation = 1/Awh (Eq. 19) (in terms of pc and pw)	CR	0.0200 Mscf/D/psia^2 20.0 scf/D/psia^2
	Assume Material Balance ignoring Zg (set $Zg=1$ at all pressures), but including "ce" term; solve as quadratic equation for pR.		
4	Effective cumulative compressibility	се	1.41E-04 1/psi
5 6	Average reservoir pressure at end plateau	pR pc	1253 psia 1113 psia
	Unmodified (Test) Well		
7	Well qg with ptmin at end plateau	qg	1.37E+07 scf/D
8	Number of wells required at end plateau	Nw	11
9	Modify dT=6 inches (inner diameter)	СТ	101521 scf/D/psia
10	Well qg with ptmin at end plateau	qg	1.91E+07 scf/D
11	Number of wells required at end plateau	Nw	8
12	Modify s=-4	CR	83.6 scf/D/psia^2
13	Well qg with ptmin at end plateau	qg	2.14E+07 scf/D
14	Number of wells required at end plateau	Nw	8
15	Modify s=-4	CR	83.6 scf/D/psia^2
16	Modify dT=6 inches (inner diameter)	CT	101521 scf/D/psia
17 18	Well qg with ptmin at end plateau Number of wells required at end plateau	qg Nw	5.67E+07 3
19	% (pc-pt) in <u>reservoir</u> at end plateau	(pc-pw)/(pc-pt)	
20	% (pc-pt) in tubing at end plateau	(pw-pt)/(pc-pt)	41 %