Misurata University
Faculty of Engineering
Petroleum Department

Final Exam
Reservoir fluids properties
Fall 2013

الاسم:------------------------------------
Date: 29/01/ 2014
Time: 2 $^{1}/_{2}$ hours

(تسلم ورقة الأسئلة مع كراسة الإجابة)

Q-1) (5 remarks)

Define the following:

-- Vapor-pressure line.

-- Melting point line.

-- Bubble point line and Dew point line.

-- Saturation envelope.

-- Retrograde condensation.

Q-2) (24 remarks)

Component	Mole fraction	Molecular weight	Critical Temp. (R)	Critical Press. (psia)	
Methane	0.85	16.04	343.3	666.4	
Ethane	0.09	30.07	549.9	706.5	
Propane	0.04	44.10	666.1	616.0	
n-Butane	0.02	58.12	765.6	550.6	
Total	1.00				

Calculate the following:

a) Gas specific gravity.

b) z-factor of the gas at pressure of 9000 psia, and temperature of 290 F.

c) Coefficient of isothermal compressibility of the gas at 3000 psia, and 200 F.

d) Viscosity of the gas at 4500 psia, and 300 F.

Q-3) (8 remarks)

A saturated crude oil exists at its bubble-point pressure of 4000 psia and a reservoir temperature of 180 F.
Given: API gravity = 50^{o} , R_s = 650 scf/STB, γ_g = 0.7
Calculate the oil density at standard conditions by using Katz method.

Q-4) (15 remarks)

Given the following data,

P_b = 2500 psia, γ_o = 0.875, γ_g = 0.775, ρ_{ob} = 45 lb/ft^3.

At 3000 psia, and 200 F, Calculate:

a) Viscosity of oil.
b) Total formation volume factor.
c) Isothermal compressibility coefficient of oil.

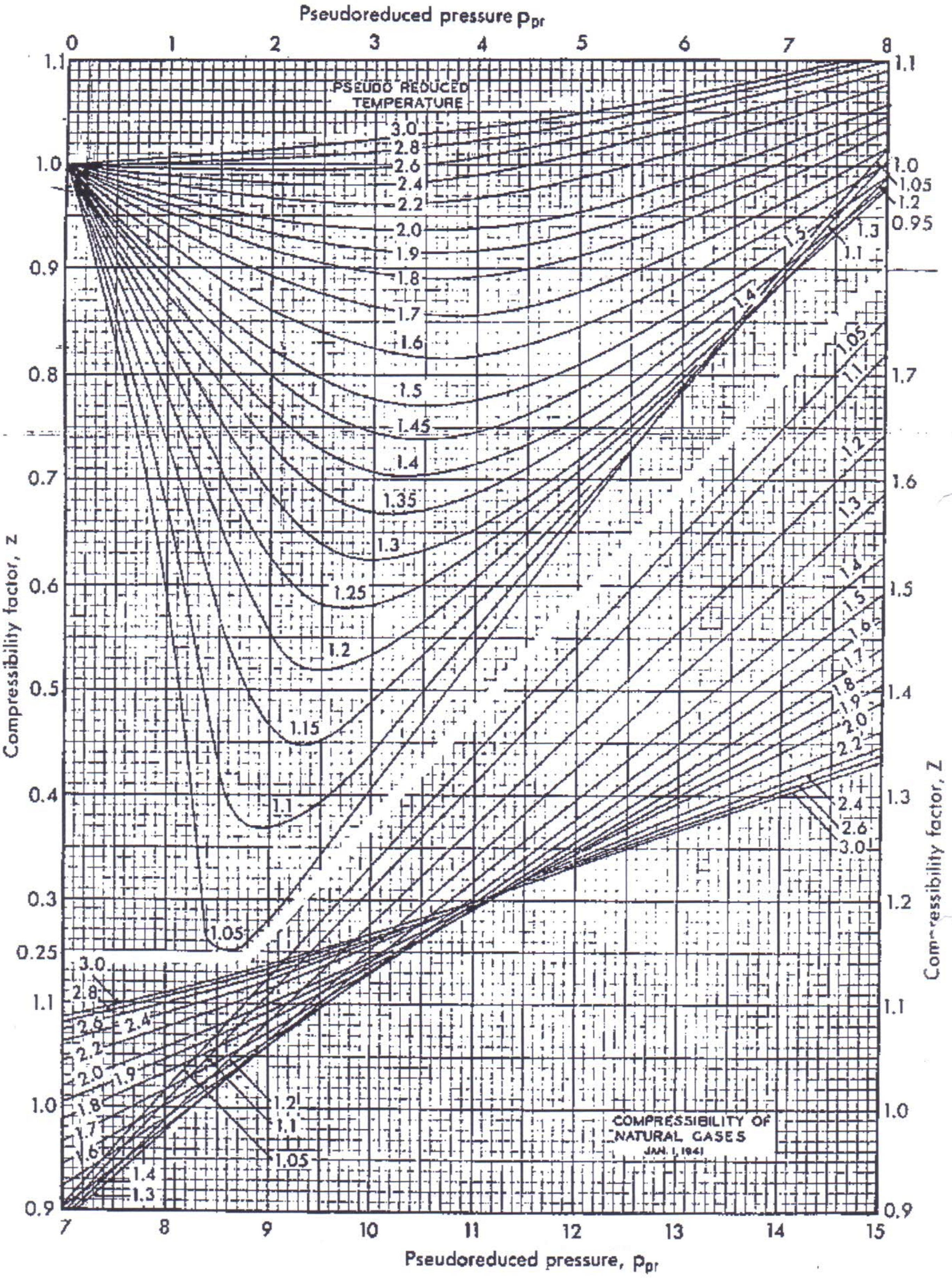
Q-5) (8 remarks)

Draw the typical relationship between the pressure and the following parameters:

Gas formation volume factor - Oil formation volume factor - Total formation volume factor - Gas viscosity - Oil viscosity - Gas solubility - Oil Density - Gas compressibility.

$T'_{pc} = T_{pc} - \epsilon$ $p'_{pc} = \dfrac{p_{pc}T'_{pc}}{T_{pc} + y_{H2S}(1 - y_{H2S})\epsilon}$,	$\mu_o = \mu_{ob} + 0.001(P - P_b)[0.024(\mu_{ob})^{1.6} + 0.038(\mu_{ob})^{0.56}$
$\mu_{od} = \left(0.32 + \dfrac{1.8(10^7)}{API^{4.53}}\right)\left(\dfrac{360}{T - 260}\right)^a$ with $a = 10^{(0.43 + 8.33/API)}$	$c_o = 10^{-6} \exp\left[\dfrac{\rho_{ob} + 0.004347(p - p_b) - 79.1}{0.0007141(p - p_b) - 12.938}\right]$ $\beta_o = 0.9759 + 0.000120\left[R_s\left(\dfrac{\gamma_g}{\gamma_o}\right)^{0.5} + 1.25(T - 460)\right]^{1.2}$
$= 18.2\,[(R_s/\gamma_g)^{0.83}(10)^a - 1.4]$ with $a = 0.00091\,(T - 460) - 0.0125\,(API)$	$\mu_{ob} = (10)^a(\mu_{od})^b$ with $a = R_s\,[2.2(10^{-7})\,R_s - 7.4(10^{-4})]$ $b = \dfrac{0.68}{10^c} + \dfrac{0.25}{10^d} + \dfrac{0.062}{10^e}$ $c = 8.62(10^{-5})R_s$ $d = 1.1(10^{-3})R_s$ $e = 3.74(10^{-3})R_s$

All the Best


Pseudoreduced pressure p_{pr}
PSEUDO REDUCED TEMPERATURE
Compressibility factor, z
Compressibility factor, Z
COMPRESSIBILITY OF NATURAL GASES
JAN. 1, 1941
Pseudoreduced pressure, p_{pr}

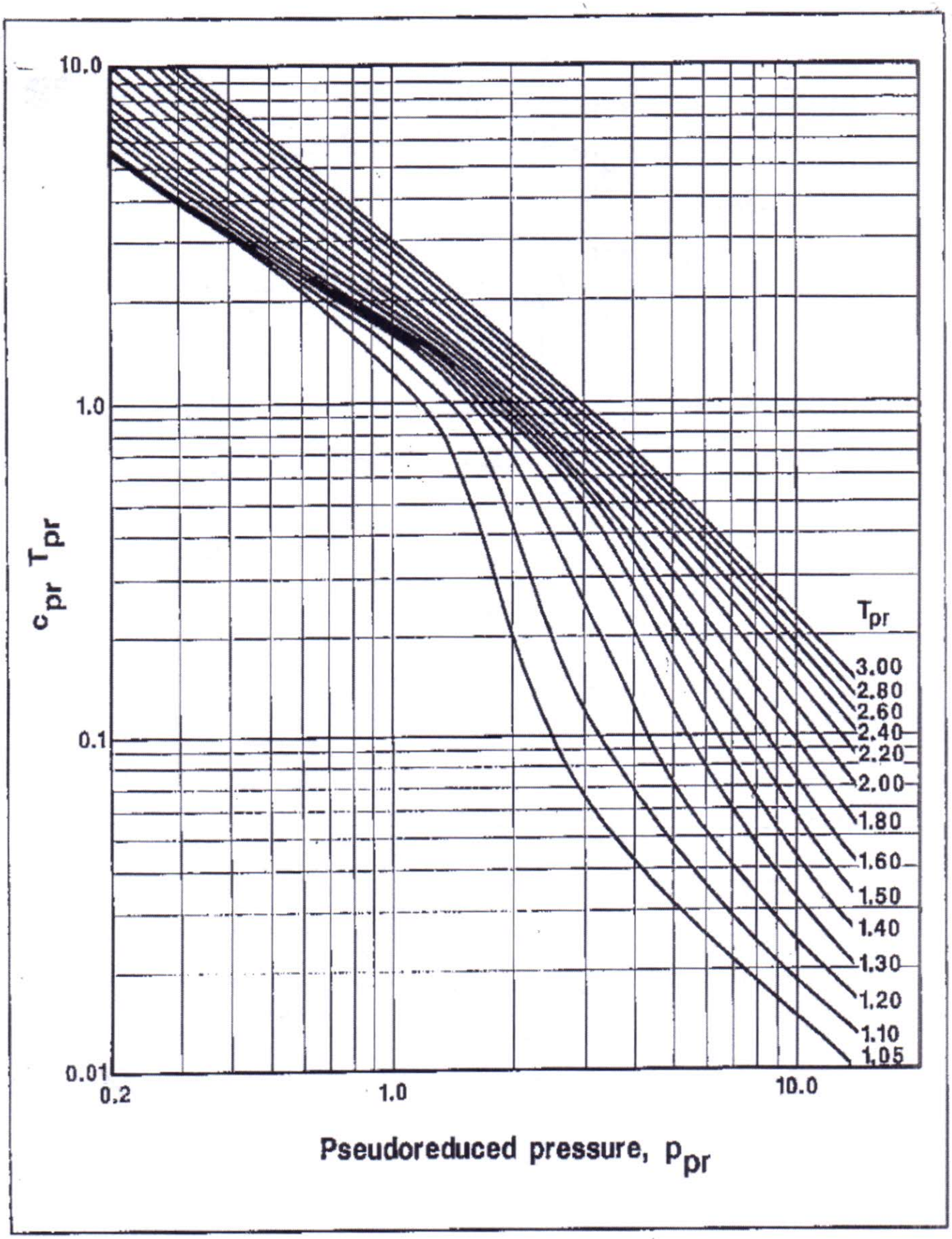
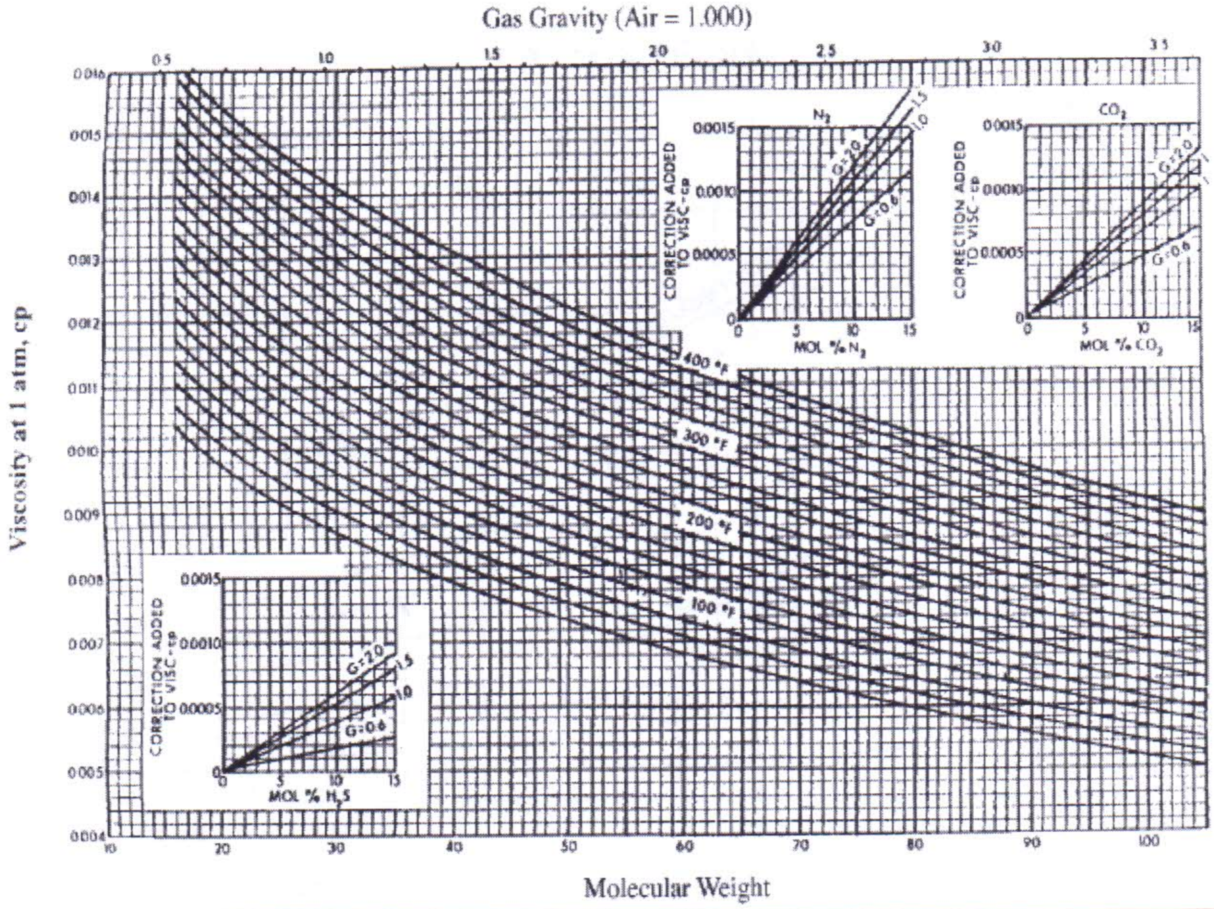
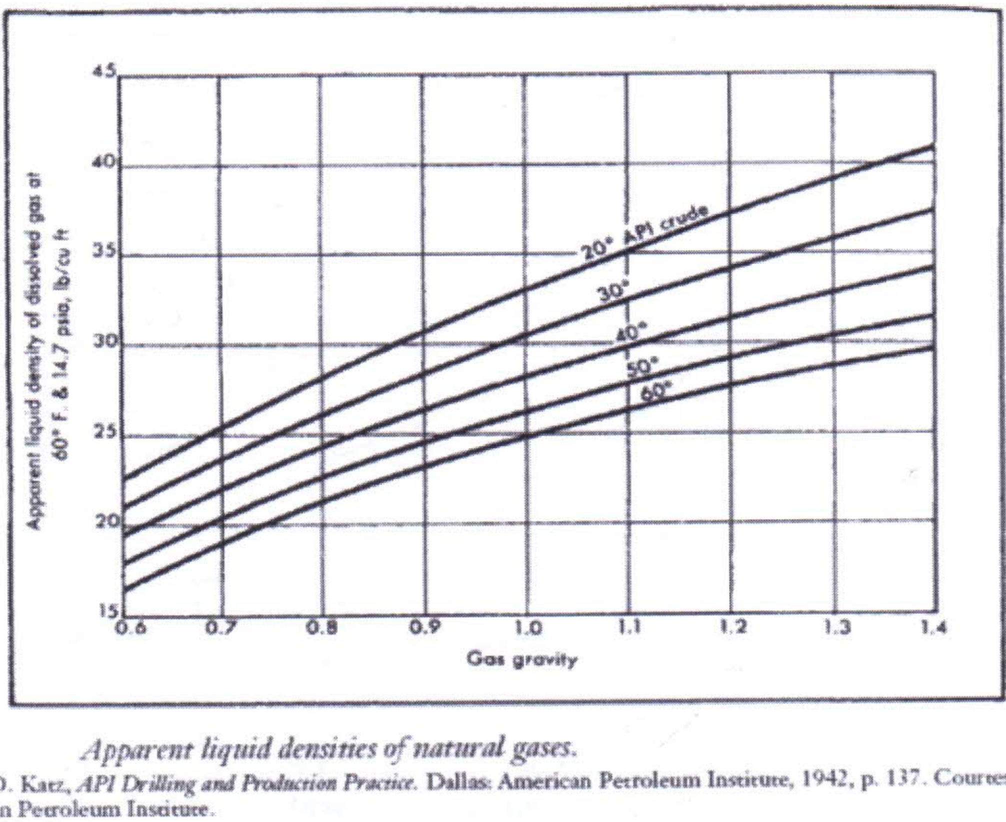


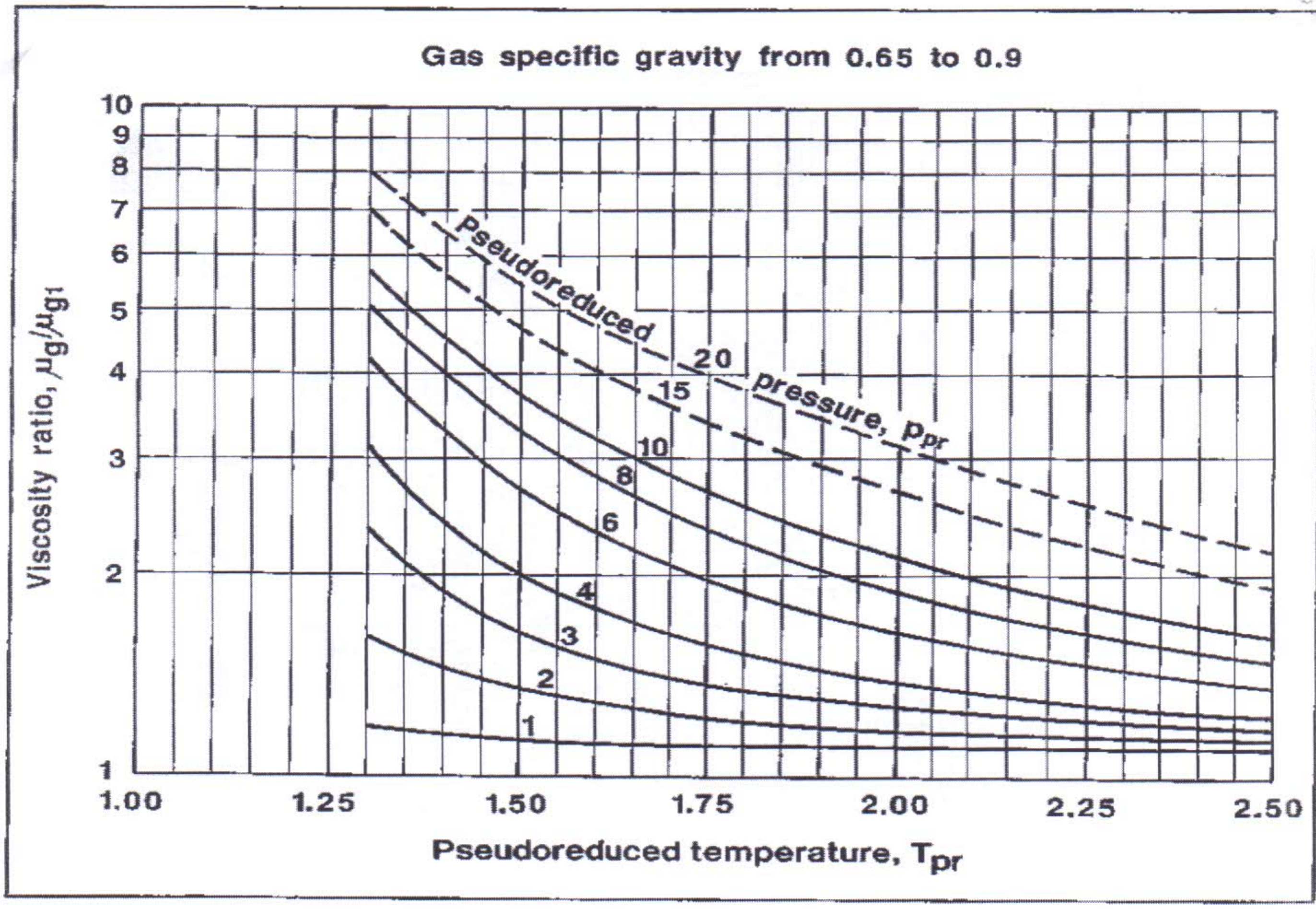
Fig. 6–4. Pseudoreduced compressibilities of natural gases.



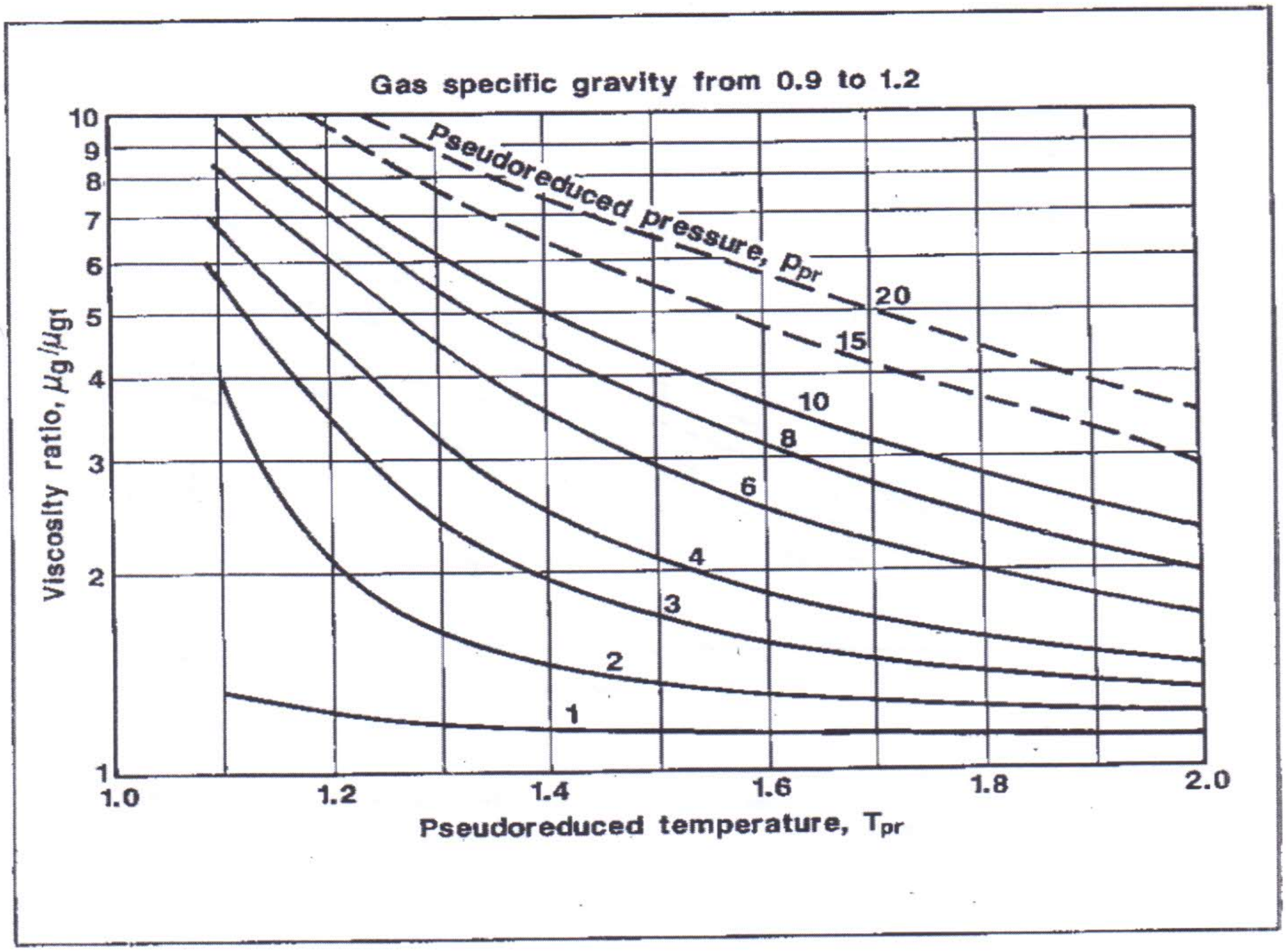


Apparent liquid densities of natural gases.

Source: D. Katz, *API Drilling and Production Practice.* Dallas: American Petroleum Institute, 1942, p. 137. Courtesy of the American Petroleum Institute.



Gas specific gravity from 0.65 to 0.9
Viscosity ratio, μ_g/μ_{g1}
Pseudoreduced pressure, p_{pr}
20
15
10
8
6
4
3
2
1
1.00
1.25
1.50
1.75
2.00
2.25
2.50
Pseudoreduced temperature, T_{pr}



Gas specific gravity from 0.9 to 1.2
Viscosity ratio, μ_g/μ_{g1}
Pseudoreduced pressure, p_{pr}
20
15
10
8
6
4
3
2
1
1.0
1.2
1.4
1.6
1.8
2.0
Pseudoreduced temperature, T_{pr}