Petroleum Engineering 311
Test 3

1/29/2003

1. A reservoir has a pore volume of 1 x 10^6 reservoir barrels at an initial fluid pressure of 4000 psig and the formation compressibility is 5 x 10^{-5} psi^{-1}. Calculate the pore volume when the fluid pressure has declined to 3500 psig. HINT: Separate the variables and integrate using the data and the definition of the formation compressibility, $c_f = +\frac{1}{V_p}\frac{\partial V_p}{\partial p_f}$.

$$c_f \int_{4000}^{3500} dp = \int_{1\times10^6}^{V_p} \frac{dV_p}{V_p} \Rightarrow V_p = (1\times10^6)e^{-(500)(5\times10^{-5})} = 0.975\times10^6 \text{ rb}$$

2. A sandstone sample was cleaned, dried, and saturated with water. The saturated sample was placed in a copper jacket and subjected to increasing external pressures at a constant internal pressure to determine its pore volume compressibility. Calculate pore volume compressibility at 2000 psi from the following data:

Net compacting pressure (psi)	Change in pore volume (cm^3)	Pore volume (cm^3)
0	0.0	25.042
1000	- 0.187	24.855
2000	- 0.112	24.743
3000	- 0.0815	24.661

$$c_f = -\frac{1}{V_p}\frac{\partial V_p}{\partial p_m} \approx -\frac{1}{V_p}\frac{\Delta V_p}{\Delta p} = \frac{0.112\ cm^3}{(24.743\ cm^3)(1000\ psi)} = 4.53\times10^{-6}\ psi^{-1}$$

3. Given the generalized form of the Darcy equation, with dz/ds = 0, $v_s = \frac{q_s}{A} = -\frac{k}{\mu}\frac{dp}{ds}$, write the names and units of the various quantities below:

Symbol	Quantity	Darcy Unit System	SI Unit System	Oilfield Unit System
q_s	volumetric flow rate	cm^3/s	m^3/s	bbl/day (ft^3/day)
A	flow x-sectional area	cm^2	m^2	ft^2
k	permeability	d	m^2	md
μ	dynamic viscosity	cp	Pa·s	cp
p	pressure	atm	Pa	psi (lbf/in^2)
s	distance along flow path	cm	m	ft