

Petroleum Engineering 310
EXAM 2
Sample 2

Name: _____

Section: _____

THIS EXAMINATION CONSISTS OF TWO PARTS

Part I has **six** problems worth **six** points each. Grading will be on the basis of approach and answers. Work out the answer in the space provided. **SHOW ALL WORK.**

Part II has **eight** problems worth **eight** points each. Grading will be on the basis of approach and answers. Work out the answer in the space provided. **SHOW ALL WORK.**

This examination is OPEN BOOK (McCain textbook and SPE 26668).

Questions are not permitted.

Do not fold or unstaple the examination booklet.

Time allotted for the examination is 120 minutes.

STATEMENT

When you have completed the examination, read and sign the statement below, then turn in the examination booklet.

I pledge that I have neither given nor received aid in completing this examination. I have followed the strictures of the Texas A&M University Aggie Code of Honor during the examination.

Signature: _____

PART I

Part I has **six** problems worth **six** points each. Grading will be on the basis of approach and answers. Work out the answer in the space provided. **SHOW ALL WORK.**

1. One lb-mole of a gas occupies a volume of 4.7 ft³ at a pressure of 1300 psig and a temperature of 185 °F. What is the z-factor of the gas at the given pressure and temperature?

2. The Rocky Mountain High Gas Field is located in the state of Colorado where atmospheric pressure averages about 12.5 psia. Assume you are collecting a gas sample in a 1 ft³ gas cylinder attached to a wellhead in the field where the temperature is 30 °F. A pressure gauge on the gas cylinder reads 45.0 psi. What is the pressure in psia? What is the pressure in atmospheres? What is the volume of the gas in the cylinder at standard conditions? How many lb-moles of gas have been collected?

3. Assuming that the apparent molecular weight of a gas is 19.21 lb/lb-mole, what is the specific gravity of the gas at a pressure of 300 psia and a temperature of 200 °F?

4. A gas has the following composition:

<u>component</u>	<u>mole fraction</u>
CO ₂	0.030
H ₂ S	0.050
C ₁	0.850
C ₂	0.023
C ₃	0.020
i-C ₄	0.015
n-C ₄	<u>0.012</u>
	1.000

Calculate the apparent molecular weight, pseudocritical temperature, and pseudo-critical pressure of the gas. Use Kay's mixture rules.

5. A cylinder contains a 1.26 specific gravity gas, having a H₂S concentration of 15 mole percent and a CO₂ concentration of 18 mole percent at 256 °F and 6460 psia. Determine the z-factor of the gas. Use the method of SPE 26668.

6. Calculate the viscosity of the gas in Problem 5 above if the pseudoreduced pressure and temperature are 10.0 and 1.5, respectively.

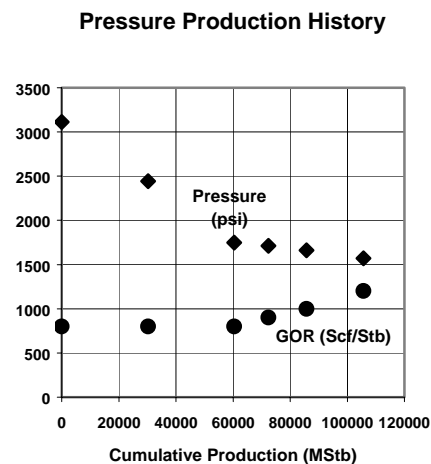
PART II

Part II has **eight** problems worth **eight** points each. Grading will be on the basis of approach and answers. Work out the answer in the space provided. **SHOW ALL WORK.**

7. A retrograde gas reservoir is produced through two stages of separation. The initial daily production is 3100 MScf of a 0.65 specific gravity separator gas, 120 MScf of a 1.20 specific gravity stock tank gas, and 242 stock tank barrels of a 48 °API condensate. Calculate the specific gravity of the reservoir gas.

8. The Kelly-Snyder Canyon Reef Reservoir produces a 40 °API stock tank oil and a 0.75 specific gravity separator gas. The early field pressure production history is shown in the figure at right. The field separator conditions are 100 psig and 70 °F.

Estimate the bubble-point pressure and solution gas-oil ratio at the bubble point for this reservoir.



Differential Vaporization at 176 °F						Flash Vaporization at 176 °F	
pressure p (psig)	relative oil volume B _{oD} (bbl/bbl)	solution GOR R _{sD} (scf/bbl)	gas deviation factor z (1)	oil density ρ _o (g/cc)	incremental gas gravity γ _g (1)	pressure p (psig)	relative volume $\frac{V_t}{V_b}$
						3,000	0.9831
						2,500	0.9874
						2,000	0.9919
						1,600	0.9958
						1,400	0.9979
1,208	1.256	355		0.7428		1,208	1.0000
1,050						1,154	1.0182
900						1,102	1.0386
750	1.216	261	0.929	0.7553	0.723	1,031	1.0692
600	1.202	229	0.940	0.7597	0.750	955	1.1101
450	1.187	196	0.950	0.7644	0.787	862	1.1716
300	1.170	162	0.963	0.7697	0.844	767	1.2533
150	1.149	120	0.981	0.7761	1.006	662	1.3765
85	1.133	95	0.988	0.7806	1.229	552	1.5614
0	1.053	0		0.8034	1.795	460	1.7978
Separator Tests							
pressure p (psig)	T (°F)	separator GOR (scf/stb)	stock tank GOR (scf/stb)	stock tank gravity (°API)	FVF B _{oSb} (rb/stb)		
0	71	335		36.4	1.238		
25	71	279	19	37.8	1.208		
50	71	252	40	38.0	1.203		
100	71	223	72	37.9	1.205		

NOTE: Use the reservoir fluid study data on the opposite page for the remaining problems.

9. Determine values of oil formation factor for use in reservoir engineering calculations at the following pressures. Assume the separator operates at 25 psig and 71 °F.

<u>pressure</u> <u>(psig)</u>	oil formation volume factor <u>(rb/stb)</u>
2000	
1208	
450	
0	

10. Determine values of solution gas-oil ratio for use in reservoir engineering calculations at the following pressures. Assume the separator operates at 25 psig and 71 °F.

<u>pressure</u> <u>(psig)</u>	solution gas-oil ratio <u>(scf/stb)</u>
2000	
1208	
450	
0	

11. Determine values of oil density for use in reservoir engineering calculations at the following pressures. Assume the separator operates at 25 psig and 71 °F.

<u>pressure</u> <u>(psig)</u>	oil density <u>(g/cc)</u>
----------------------------------	---------------------------------

2000

450

12. Determine values of oil compressibility for use in reservoir engineering calculations at the following pressures. Assume the separator operates at 25 psig and 71 °F.

<u>pressure</u> <u>(psig)</u>	oil compressibility <u>(psi⁻¹)</u>
----------------------------------	---

2000

13. During the differential liberation test, 1.87 cm³ of gas and 88.2 cm³ of oil were measured in the cell at 900 psig. The gas was displaced at constant pressure and its volume at 15.025 psia and 60 °F was determined to be 101.8 cm³. Calculate the z-factor of the gas at 900 psig.

14. During the differential liberation test, 1.87 cm^3 of gas and 88.2 cm^3 of oil were measured in the cell at 900 psig. The volume of residual oil in the cell at 0 psig and $60 \text{ }^\circ\text{F}$ was 71.7 cm^3 . Calculate the relative oil volume at 900 psig.